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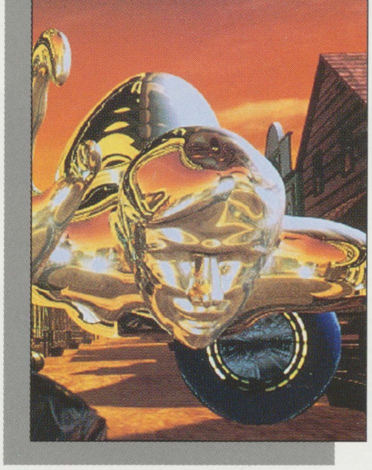
COMPUTER GRAPHICS WORLD



A new computer technology adds realism to all sorts of organic-looking models, from dinosaurs to humans, p. 26.

Analyzing CAD Models From the Inside Out

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A Buyer's Market for 24-Bit PC Boards

Sketch Modeling

Compressing Images on the PC and Mac

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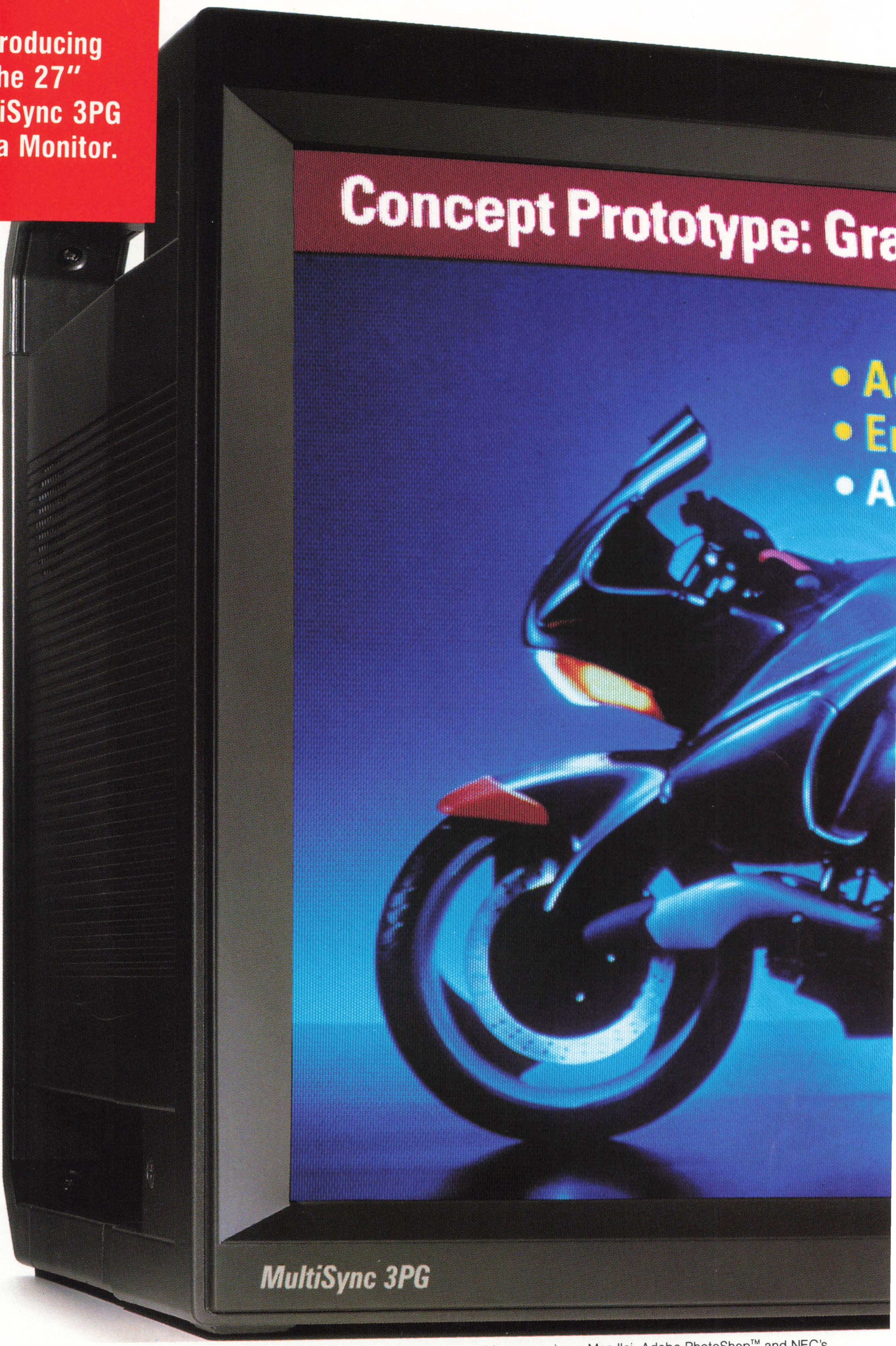

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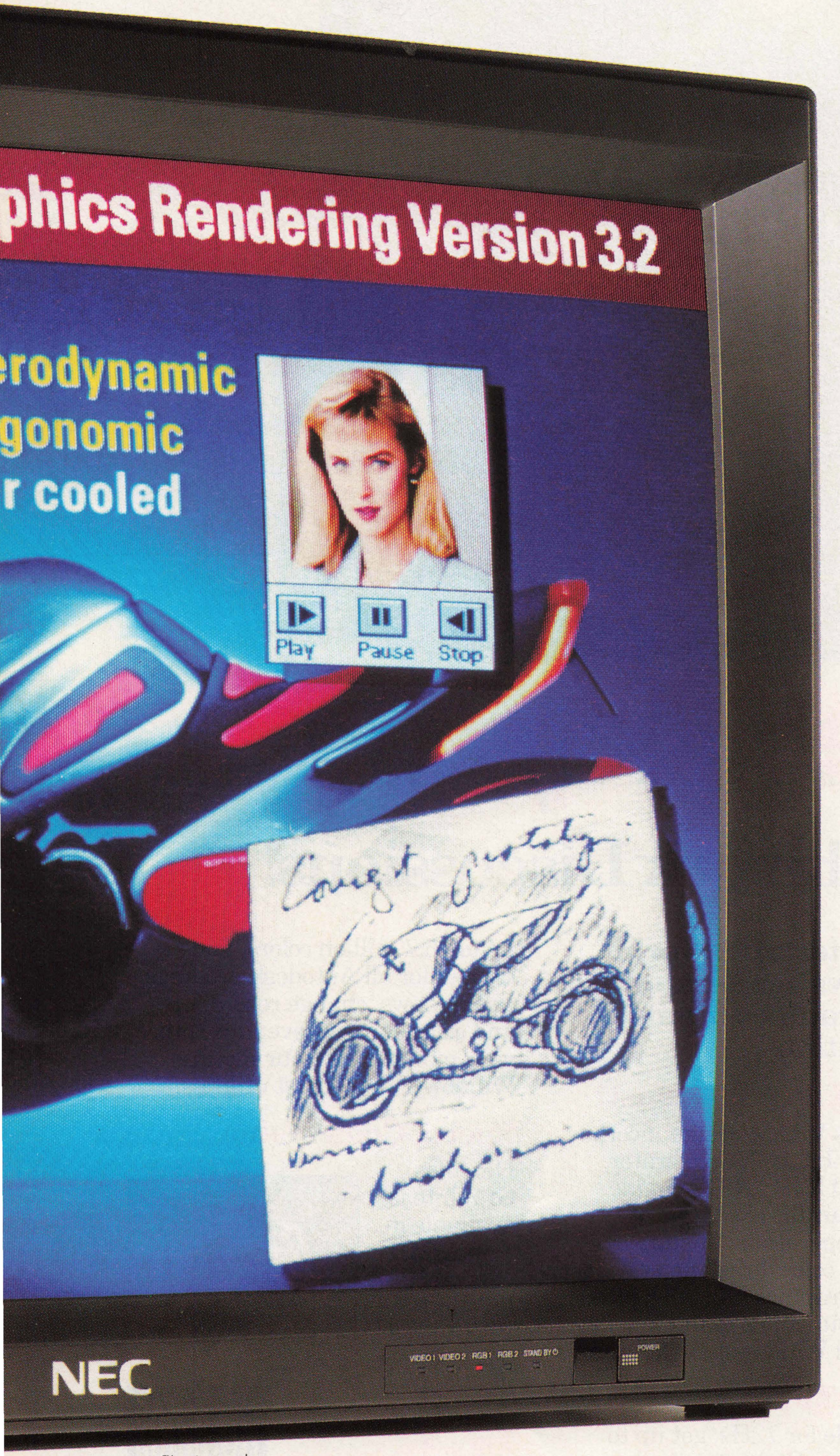
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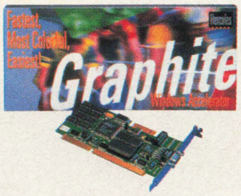

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CIRCLE 2 ON INFORMATION CARD

COMPUTER
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COVER

The data for the connecting rod image was created with SDRC's I-deas software and visualized with the Cardinal Vision-FEA finite-element analysis program. Image recording courtesy of G.W. Hannaway & Associates (Boulder, CO). For more information on the latest in finite-element analysis software, see page 21.

FEATURES & COLUMNS

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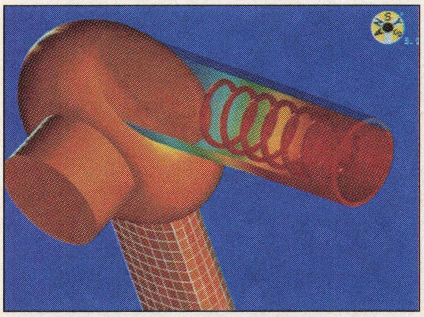
FEA to the Core

The concept of trying to understand an object's behavior by visualizing only its outer surfaces illustrates a barrier to understanding finite-element analysis that has existed for nearly 15 years. But now, vendors are enhancing their old postprocessors to include new visualization tools, including several that make it possible to see FEA results in the interior of a model.
By Caren D. Potter



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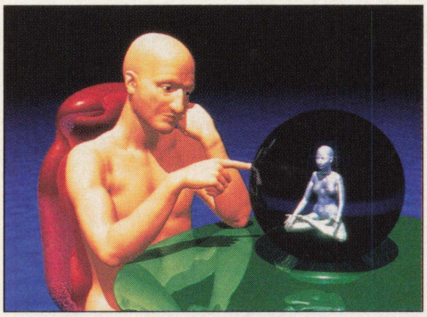
The Magic of Metaballs

A new technology called Metaballs is giving shape to all sorts of realistic, organic-looking creations, from dinosaurs to sea cows and from pouring liquids to human beings.
By Gaye L. Graves



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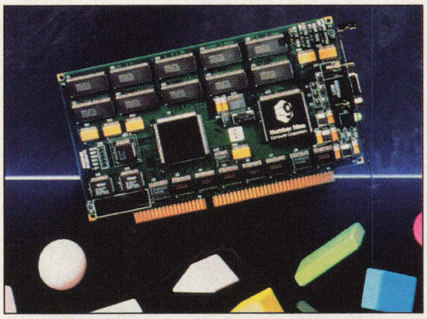
Board Games

Now that 24-bit color and Windows have become standard features of most PC graphics boards, it's more or less a buyer's market for anyone looking to purchase a 24-bit board to meet their full-color graphics needs. But if you don't do your homework, you could get burned in the process.
By Barbara Robertson



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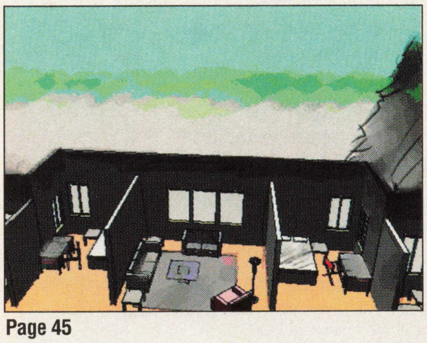
Sketch Modeling

Early in design, architects have traditionally made quick, rough sketches instead of the precise, studied drawings they produce later as construction documents. Today, a variety of low-end sketch modeling programs are available which support this schematic design process by allowing users to explore techniques for drawing in 3D in a way that feels more like freehand sketching.
By Bobby-Jo Novitski



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Stephen Porter
Editor

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Managing Editor

Barbara Robertson
West Coast Senior Editor

Gary Pfitzer
Senior Associate Editor

Diana Phillips Mahoney
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Laureen Belleville
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Michelle Lendway
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Contributing Editors: Cynthia Baron, James Cavuoto, John Gantz, Laura Lang, Renée LeWinter, Gregory MacNicol, Joel Orr, Peter Sørensen, Terry Wohlers

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Graphics Group Circulation Director

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Marketing Communications Director

Barrie Evans
Marketing Assistant

Paul McPherson
Group Sales & Marketing Manager

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Group Publisher

COMPUTER GRAPHICS WORLD
Executive and Editorial Offices:
One Technology Park Drive, POB 987
Westford, MA 01886
(508) 692-0700 FAX: (508) 692-7806

For subscription inquiries only:
TEL: (918) 835-3161 ext. 400
FAX: (918) 831-9497; TDD: (918) 831-9566

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Advanced Technology Group

Dr. Morris R. Levitt
Senior Vice President

Leslie P. Cypret
Vice President Administration

Mari Rodriguez
Group Production Manager

Paul Westervelt
Circulation Director

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FRONT END

Crossing the Lines Between Applications

As I was reading through the articles in this month's issue, one of the quotes that caught my eye came from Richard Gallagher at Swanson Analysis Systems, who was discussing some new developments in finite-element analysis technology. Traditionally, the computer models created with FEA software have only allowed engineers to see how various stresses and strains were impacting the exterior surface of a model. But recently, new visualization techniques have emerged that allow engineers to look inside a model to see what's going on underneath the skin.

In explaining how these new visualization techniques came about, Gallagher noted that, "At graphics conferences, we'd bump into people involved in medical and satellite imagery and consider applying what they were doing to the visualization of analysis behavior."

The notion that these new FEA visualization techniques were inspired by techniques first used in the medical visualization world is interesting because it verifies an idea that is very near and dear to our hearts here at *Computer Graphics World*. That idea is that graphics technologies—be they 3D modeling, animation, visualization, virtual reality, imaging, or even multimedia technologies—are not application-specific.

Time and again, we see technologies and techniques developed for use in one application area being applied to entirely different sets of problems by someone in another application area. And time and again, we talk to vendors who express amazement at the number of users who are using their products in ways never envisioned by the original developers of the product.

At a recent industry conference, Alias Research president Rob Burgess gave a talk in which he explained how his company's animation/modeling software is used by both industrial designers and Hollywood animators. In explaining this, he noted that the animators tend to always be pushing for better and better animation techniques while the industrial designers push for new developments in modeling. Inevitably, however, all the techniques find uses in both worlds.

At *CGW*, we don't tend to view ourselves as just a CAD magazine or just a scientific visualization magazine or just a computer art magazine. We think of ourselves as a computer graphics magazine, and one of our main goals is to highlight the newest developments in that technology and explain how it's being put to use in innovative, new ways in various application areas.

Those who appreciate the application-independent nature of graphics technology often express delight at the creative insights that a magazine like *CGW* helps foster. Those who don't appreciate it, however, never quite seem to understand what it is that a scientist and an engineer or an architect and an animator might have in common.

Stephen M. Porter

Stephen M. Porter
Editor

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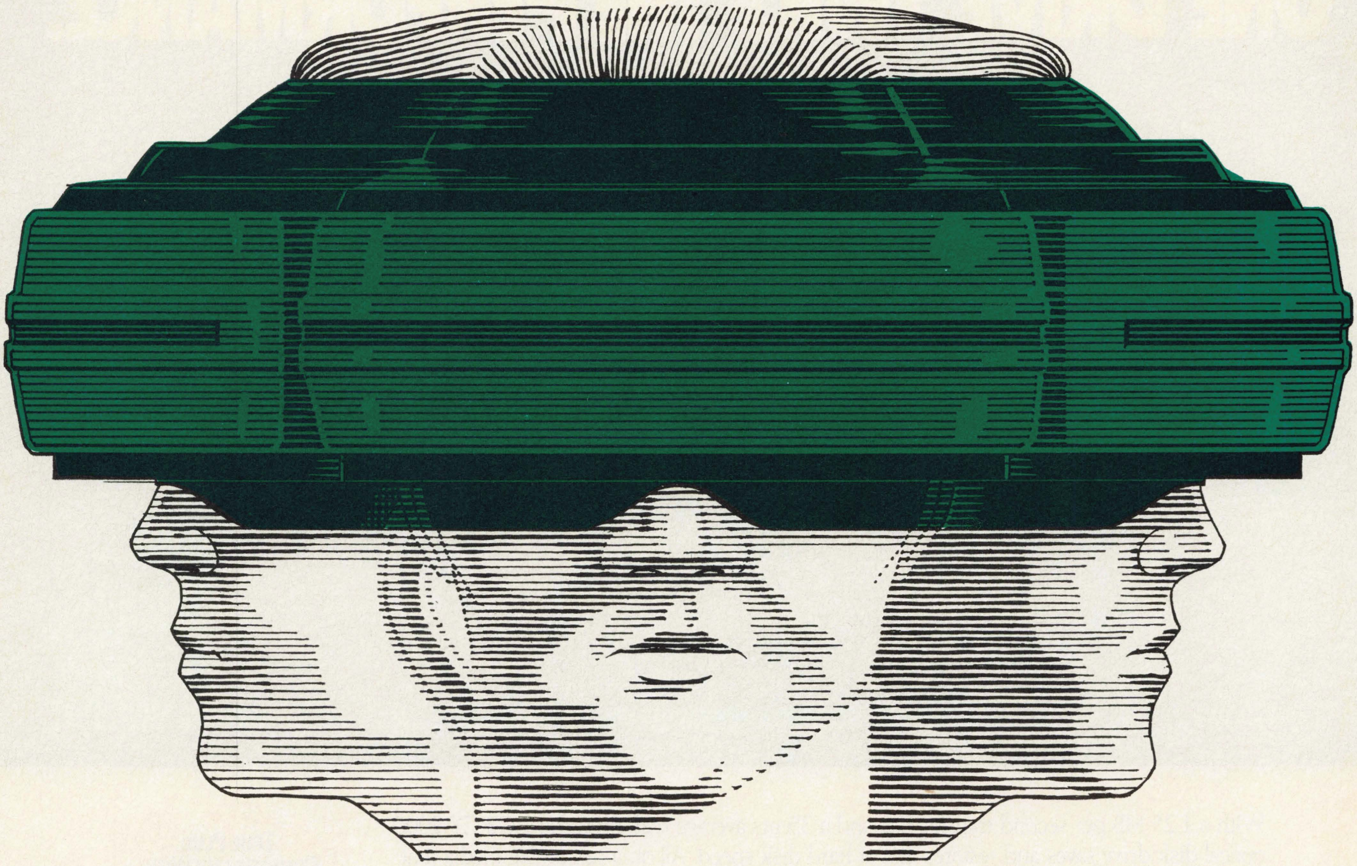

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CIRCLE 4 ON INFORMATION CARD

News in Brief

IBM Gets Into the Special Effects Business

Attracted by the potentially big profits in the entertainment field, IBM (Armonk, NY) has announced it is joining forces with three key figures in the film industry to create a visual effects and digital production studio called Digital Domain. IBM is being joined in the venture by writer/director/producer James Cameron, Academy Award-winning special effects wizard Stan Winston, and Scott Ross, a visual effects studio executive under whose leadership Industrial Light & Magic won four Academy Awards. According to IBM, Digital Domain will provide support services for artists looking to use the latest computer equipment to create special effects for feature films, television, commercials, and simulator attractions. In addition, Digital Domain will create its own software for these media as well as for the fields of interactive entertainment and education.

"The future of entertainment and communication lies squarely in the digital domain," says Cameron, who wrote, produced, and directed *Terminator 2: Judgement Day*, 1991's top-grossing film. "Digital Domain will be the place for creators to go to realize the pictures in their heads."

Digital Domain will locate its facilities in the Los Angeles area. Cameron, Winston, and Ross will serve on the board of directors, with Cameron as chairman. Ross will manage daily operations as president and CEO, while both Cameron and Winston will focus on the company's near- and long-term strategic direction.

New Joint Venture to Develop Compression and Interface Technologies

Four Japanese firms—Hitachi, ASCII, Japan Victor (JVC), and NTT Electronics Technology—have joined forces to create a new joint venture firm, Graphics Communication Laboratories, whose goal it will be to develop compression and interface technologies that will enable users to exchange digital data between a variety of media, including high-definition televisions (HDTV), broadband Integrated Services Digital Networks (ISDN), and optical disks. According to an ASCII spokesperson, once the technologies are in place it will be possible to integrate almost any HDTV picture, including the Japanese, American, and European types.

Virtual Reality-Based Entertainment for the Mass Market

Visions of Reality Corp. (South San Francisco) has established a strategic alliance with Kaiser Electro-Optic Inc. (Carlsbad, CA) and an exclusive software licensing agreement with Sense8 Corp. (Sausalito, CA) to create virtual reality-based entertainment for the mass market. Under the agreements, Visions of Reality gains exclusive rights in the public entertainment market for Kaiser's head-mounted display technology and Sense8's WorldToolKit software development technology. Visions of Reality plans to launch its first product, a virtual reality-based game system, later this year.

Cadam Changes Name, Unveils New Desktop Software Mission

IBM's design automation software subsidiary, Cadam Inc. (Burbank, CA), has changed its name to Altium and has unveiled an aggressive new mission that it hopes will reinforce its vitality in the marketplace.

According to Altium president Lee Murray, Altium has invested more than 30 percent of its revenues in new-product-related development efforts during 1992 and is currently in the process of incorporating major improvements in its existing product line, including design automation software sold under the Micro Cadam, IBM CAD, and P-CAD brand names. In addition, in recent months Altium acquired the rights to sell software developed by other companies as part of the Altium product family and has modified its software products to run on hardware platforms made by workstation companies other than IBM, such as Sun Microsystems and Hewlett-Packard.

Intel Begins Shipping its Power-Packed Pentium

Intel Corp. (Santa Clara, CA) has announced it has begun shipping initial production versions of Pentium, a new processor that promises up to five times the power of Intel's '486 chip while maintaining full compatibility with software written for the '486 as well as for other Intel microprocessors. Targeted at areas such as scientific modeling and CAD/CAE as well as for the Windows, OS/2, Windows NT, NextStep 486, Unix, and Solaris operating systems, the processor will also provide the increased performance necessary for new applications such as voice recognition, imaging, and real-time video, according to the company.

Pentium is available in 66- and 60MHz versions. The 66MHz processor operates at 112 V1.1 Dhrystone MIPS and has a SPECint92 rating of 64.5, a SPECfp92 rating of 56.9, and an iCOMP index rating of 567, according to Intel. The performance difference between the 66- and 60MHz versions is about 10 percent.

Joint Developments

The MacNeal-Schwendler Corp. (MSC; Los Angeles) has announced that it will resell in North America **Wavefront Technologies'** (Santa Barbara, CA) Data Visualizer software as a graphics postprocessor for the MSC/Dytran analysis program. **Matra Datavision** (Tewksbury, MA) has announced a direct link between its Euclid-IS software and the **Stratasys** (Minneapolis) 3D Modeler for rapid prototyping. The link will enable users to design complex parts and assemblies, then produce accurate prototypes for industrial design, interference checking, quality control, design optimization, and wax patterns for castings. **Cadkey Inc.** (Windsor, CT) is bundling with its Cadkey 6 CAD software the **Fast-Surf** surface modeling program.

■ ALSO OF NOTE

- **Pixel Resources Inc.** (Norcross, GA), developer of the Pixel-Paint product line, has announced that it has reacquired from **Super-Mac Technology** (Sunnyvale, CA) all marketing, manufacturing, and publishing rights to PixelPaint Professional, a 24-bit color paint package for the Macintosh.

- **Horizons Technology Inc.** (HTI; San Diego) has announced that it has acquired exclusive worldwide rights to the True Motion compression algorithm developed by New York-based **Duck Corporation**. True Motion reportedly provides the highest-quality compressed video available for Intel Corporation's i750 chip set.

- Chipmaker **Motorola Inc.** (Austin, TX) has announced that it has invested in **Virtus Corporation**, a Cary, North Carolina-based company specializing in 3D and virtual reality software for desktop computers.

- **Network Computing Devices** (Mountain View, CA) has been selected as the only vendor to supply X terminals to **NASA** under the Scientific and Engineering Workstation Procurement program. The contract has a potential value to NCD of $4 million, representing several thousand color X terminals, over the next five years.

News compiled and reported by Audrey Doyle, CGW *managing editor.*

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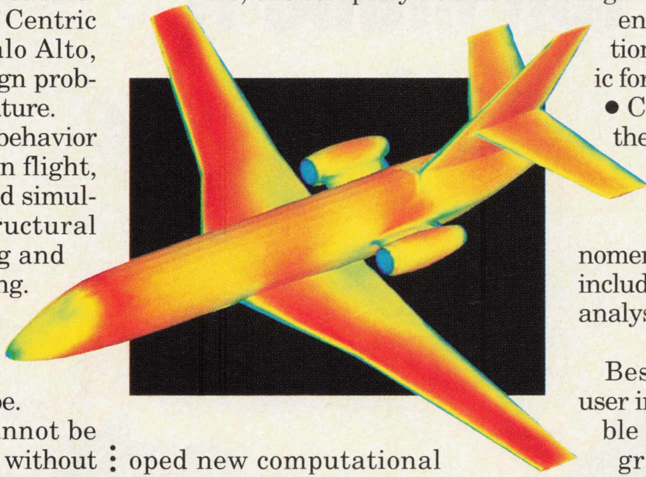
CIRCLE 5 ON INFORMATION CARD

Holistic Analysis Tool Offers Realistic Simulations

One of the problems with traditional finite-element analysis programs is that they force engineers to analyze one category of physical phenomena at a time—be it fluid, solid, thermal, or magnetic—segregating it, in effect, from any related physical phenomena.

Unfortunately, says Cliff Schwieter, president and CEO of Centric Engineering Systems (Palo Alto, CA), most mechanical design problems are multiphysics in nature.



The shape and dynamic behavior of the wing of an aircraft in flight, for example, are determined simultaneously by both the structural characteristics of the wing and the fluid flow across the wing. The shape of the wing determines the flow, but the flow creates pressures on the wing that affect its shape.

The two phenomena cannot be separated, says Schwieter, without risking the kind of problems encountered by the Voyager aircraft, whose round-the-world trip nearly ended on takeoff when uncalculated aeroelastic effects caused its wings to drag on the runway, causing the tips to be scraped off.

To avoid these kinds of problems, Centric has developed Spectrum, a new type of analysis program that allows engineers to comprehensively simulate the true behavior of products by simulating the multiple, interacting physics inherent in real-world engineering designs. Billed as a "simulation-based design system," the program takes a kind of holistic approach to design analysis.

Though the program is based on the finite-element method of analysis, the company has developed new computational mechanics technology and algorithms to give the product its multiphysics capability. According to the company, Spectrum can handle three different classes of problems:

- Interacting problems, which are those in which two or more geometrically distinct regions interact with one another at their boundaries through the transfer of motion, forces, and heat. One example of such a problem would be the effects of wind and waves on a building or bridge.
- Coupled problems in which the behavior and response of a geometric region is characterized by simultaneous physical phenomena, some or all of which depend upon one another. Some of the phenomena acting on the solid might be thermal energy, chemical reactions, motion, sound, pressure, or magnetic forces.
- Concurrent problems in which the behavior or response of a geometric region is characterized by multiple, but independently acting, physical phenomena. Sample applications would include automotive crashworthiness analysis and under-hood cooling.

Besides featuring a graphical user interface, Spectrum is compatible with such popular FEA programs as Ansys, Nastran, Patran, and I-deas. It also features a scalable architecture that allows it to make optimum use of massively parallel computers. The product, which was scheduled to be shipped this spring, will run on Convex, Cray, IBM RS/6000, Silicon Graphics, Sun Microsystems, and Thinking Machines hardware platforms. Licensing fees range from $30,000 to $150,000, depending on the platform.—*Stephen Porter,* CGW *editor*

If the Computer Fits ... Wear It

If you're looking for the latest trends in high-tech fashion, one place you'll want to be sure to check out is the Design for Manufacturing laboratory at Carnegie-Mellon University's Engineering Design Research Center in Pittsburgh. With the backing of some National Science Foundation funding, students there are hard at work pushing the leading edge in "wearable computers."

"The main purpose of wearables," says Daniel Siewiorek, director of the lab, "is to try to merge information space with people's work space." Although computing technology has evolved over the years from centralized mainframes to desktop PCs, Siewiorek points out that the fundamental input/output devices associated with computing haven't really evolved much beyond keyboards and monitors.

"We want to break out of the standard input/output paradigm," says Siewiorek. "What people are looking for, effectively, is hands-off computing."

By taking advantage of modular architecture, voice-activated interfaces, and see-through displays, Siewiorek predicts people one day will carry important data and programs with them to assist in everyday work.

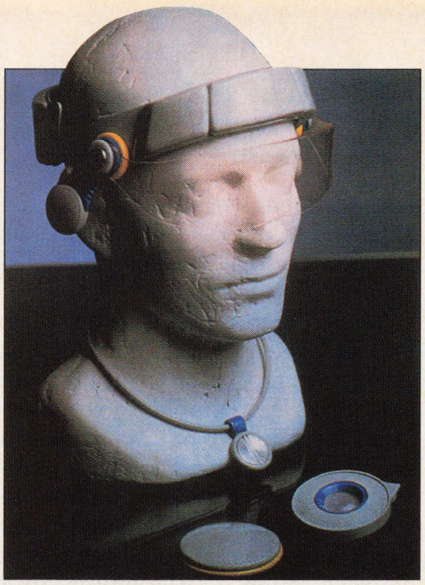
And with visors hooked to cigarette-pack-sized PCs, "You can now have see-through reality," says Siewiorek. Unlike virtual reality, which requires you to generate a full image for people to look at, Siewiorek explains that see-through reality allows people to superimpose the information they need for a particular task over natural backgrounds.

Surprisingly, wearable computer technologies are already fairly sophisticated. For example, Siewiorek's design students (actually a group of engineering managers) in a continuing education class began a summer project in 1991, creating and manufacturing a portable PC device for reading blueprints.

After just 12 weeks, the students had created a portable hardware system known as Vu-Man 1. It consisted of a 2-pound PC/AT-compatible computer with a three-button input device embedded in its housing and a Private Eye display. Since then, the system has been miniaturized to a ½-pound computer with twice the functionality that is worn on a belt.

Now students are working on a third-generation power pack called the Navigator. "It's composed of four modules: display, speech recognition, position sensing, and telecommunications," Siewiorek says. "We're using a 25MHz Intel '386 processor with 16M of memory and an 85M miniature disk drive. The computer will run a time-sharing operating system and feature an X Windows interface to make entry of objects easier.

"Then," he adds, "we have a '386 DOS-based system for speech recognition. And we also have a Global Positioning System [GPS] card and



a cellular telephone, so we can do telecommunications. And we're trying to finish this all by June."

And how might these wearable computers be used? According to Siewiorek, the possibilities are endless.

One example: campus tours. Picture new students trying to find their way around campus wearing visors or head-mounted displays. Their trusty portable PC packs could be equipped with position-sensing and navigation equipment, and with a simple voice-activated command, they could pull up maps or textual information that helps them figure out how to get where they need to go.

"The scenario is futuristic," Siewiorek acknowledges, "but when you come on campus, you'd get 30 seconds worth of instructions, and then you could ask where a particular science department is. There will be footsteps on the screen leading you to the right place. That's the system we're working on now. The Navigator."

Another example: mobile Fodor's guides. A PC on the body would let you know about traffic conditions as you head into a strange city. It would guide you to the right hotels, help you make reservations, and point you to the most convenient restaurants.

Another example: Blueprint reading and construction supervision. Consider the hapless technician looking at blueprints as he stares at an opening in an aircraft wall trying to figure out where to wire or solder.

"In this situation," says Siewiorek, "what you'd like to see is different electrical structures superimposed on each other. During the construction phase, while the wall is open, you'd use the portable PC and visor to see an image of where you should be routing electrical wires. You'd see the graphics of the electrical circuit superimposed over the physical structure; you'd see only that aspect of the blueprint required for that particular job at that given moment."

Meanwhile, the quest to further improve wearable computers goes on. "Our industrial designers are going wild trying to develop alternative displays so they can get the devices off their heads," says Siewiorek. "In construction and manufacturing, people are used to wearing hard hats. But for the general public, we need to create different forms of interfaces to make wearable computers work."—*Arielle Emmett, a freelance writer based in Wallingford, Pennsylvania*

Acoustically Correct Home Theaters

■ For the past 25 years, John Storyk has spent most of his time designing professional recording studios. In all, he's built more than 500 of them for such prestigious clients as Jimi Hendrix, Atlantic Studios, Bob Marley, and Whitney Houston.

But in the last year, he's turned more of his attention in another direction—designing "acoustically correct" home theaters and business conference rooms. Helping him in this endeavor is a homegrown computer program that uses ray-tracing to graphically depict the way sound waves are bounced, bent, and scattered throughout a room.

An acoustically correct room, Storyk explains, is one that utilizes optimal sound patterns to create a rich and pleasing environment for listening.

About a year and a half ago, Storyk, a principal designer and co-owner of Walters Storyk Design Group (located in New York City and Highland, New York), and Marcolm Young, a computer specialist in Storyk's firm, set about devising ray-tracing LIST routines for the company's Autocad platform. The result of their work was a 2D acoustical ray-tracing program called CART (Computerized Acoustic Ray Tracing).

"There are at least half a dozen acoustical issues to consider when designing any room," Storyk explains. "One is keeping a room quiet for sound transfer. Another is controlling the scattering and diffusion of mid- to high-frequency sound waves, which can seriously deteriorate original sound quality. The latter issue lends itself to a 2D ray-tracing software program.

Customized Rays

"Ray-tracing of sound waves isn't a terribly new idea," Storyk notes. "There are other companies with 2D or 3D ray-tracing programs, but we felt it would be easier to develop a software package that specifically responded to those changes in sound variables that we were most concerned about in our work. For example, we needed the ability to change surfaces quickly to find out what will happen if we put a certain material in a room. We also needed to experiment with the angles of the rays and to address such issues as the Q factor or dispersion factor of speakers."

While the program does not work for low-frequency vibrations, it does give a designer an accurate picture of reverberation problems (reverberation is the length of time it takes a sound level in a room to decay to inaudibility after the original signal stops) as well as interfering echoes that reach the ear from both direct sources (such as a speaker) and reflected sources (such as a mirror on the wall). These kinds of phase conflicts can muddy or deaden the quality of sound. They can also drown out conversation or produce an unnatural emphasis on certain vocal frequencies, sometimes making dialog unintelligible.

"This particular software has a billiards-game effect," says Storyk. "It uses ray-tracing and reflection to address the frequency-scattering and diffusion issues.

"What you see when you run the program is a bunch of rays—lines actually—bouncing off walls," he says. "How many times they go out and bounce is a function of the variables we input."

Cutting Design Time

The program has helped Storyk speed up his acoustical analysis of room angles and absorption materials for new designs. It has also made his designs more acoustically rigorous.

"Before CART, we either didn't do ray-traced analysis, or we guessed at it or did we did it by hand," he says. A single wave could take an hour to draw; many of the more complex auditory patterns were never even attempted.

"It's true that in many instances, you don't need to measure every ray to determine the answer to each acoustical question," Storyk says. "But in complex room geometries, acoustical results are not so obvious. That's where CART is useful. It allows us to do what-if analyses of multiple variables affecting audio quality." —*AE*

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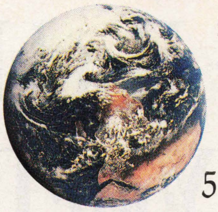

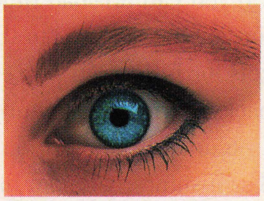

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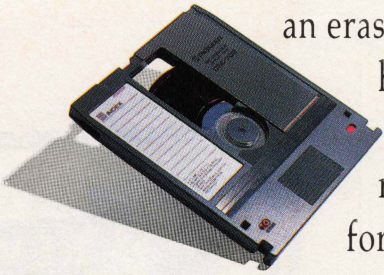

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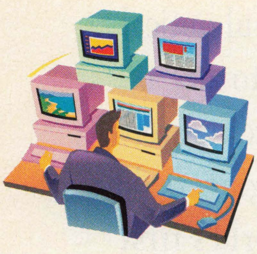

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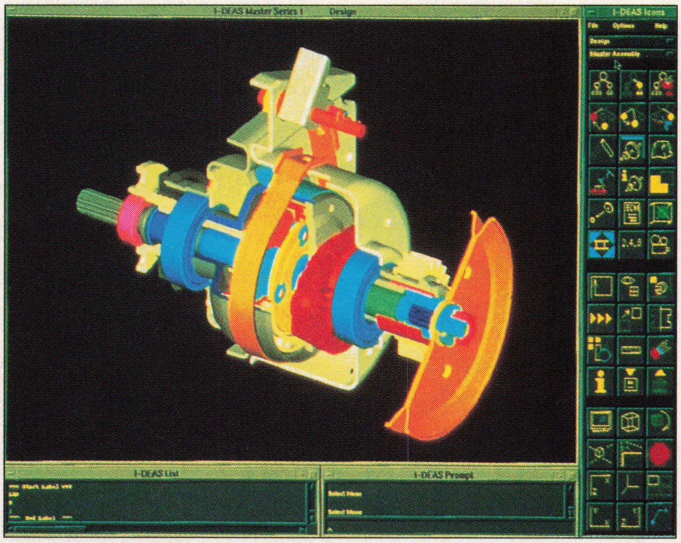
A New I-dea in Mechanical Design



Milford, Ohio-based SDRC has turned up the heat in the mechanical design marketplace with the introduction of a new generation of software that it claims will "revolutionize the way companies design and manufacture their products." The new I-deas Master Series, SDRC says, is a completely re-architected version of its traditional I-deas software.

According to SDRC chairman and CEO Ronald J. Freidsam, the company has been working on the product for the last seven years. "This has been the biggest product development effort in the company's history," says Freidsam. "This is now unquestionably the easiest-to-use system in the industry ... and the most functional."

In addition to creating "a new technological foundation" for its software, SDRC says it has added 30 new software modules to its product line and thousands of new features and enhancements. Among other things, the I-deas Master Series sports a redesigned interface with a streamlined command structure; new, intelligent drafting capabilities; a new Master Surfacing module with variational shaping capabilities that allow users to directly control and reshape surfaces; a new Simulation Advisor module that uses embedded knowledge to help guide users through a design analysis process; and a capability that the company has labeled "concurrent associativity."

During product demonstrations, SDRC has taken pains to contrast its new concurrent associativity concept to the bidirectional associativity concept touted by its chief competitor, Parametric Technology Corporation. Concurrent associativity, says SDRC, allows multiple engineers and analysts in different application areas to work simultaneously on a design model with the assurance that their application information will be automatically regenerated to reflect any design changes made in subsequent versions of the "master model."

The key advantages of concurrent associativity versus bidirectional associativity, says SDRC, are that it allows multiple engineers to work on a design at once, it offers a higher degree of associativity, and it provides more sophisticated control over the propogation of design changes. In addition, SDRC's system offers the ability to prevent unauthorized changes to the "master model," while also providing user flexibility in handling design changes made in the middle of the design process.

As part of its concurrent engineering strategy, SDRC has also developed a Team Data Manager module that provides tools for managing the design process. These tools include an automatic E-mail notification capability that informs engineers about important design changes made by other engineers working elsewhere in the design process.

Sitting at the heart of the I-deas Master Series system is the I-deas Master Modeler, a feature-based, dimension-driven solid modeler that utilizes variational geometry. The Master Modeler serves as the nucleus for all I-deas applications because of its tightly integrated database, which combines wireframe, solids, and surface data within a single data structure.

The models created with the Master Modeler, says SDRC, incorporate virtually every aspect of the design, including dimensions, variational constraints, assemblies, drawings, tolerances, and manufacturing data, eliminating the need for users to re-create data in the product development process.

SDRC is expected to begin shipping the Master Series software in Q2. Prices for single users vary depending on the modules purchased. The I-deas Drafting module, for example, is priced at $6000, while the Master Modeler module is priced at $10,000. An I-deas Team Design Package, which includes the Assembly, Drafting, Team Data Manager, and Master Modeler modules, costs $22,000.—*Stephen Porter, Editor*

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FIGARO+ supports Windows NT in 1993!

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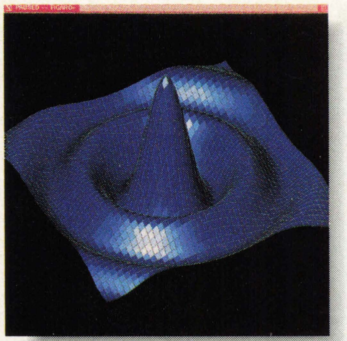

FIGARO+ programs will run on platforms from PCs to supercomputer.

Open graphics programming has arrived in a big way.

In fact, it seems like everyone now offers some sort of "open" solution.

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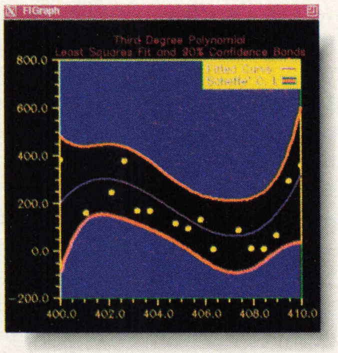

With 2 calls, FIGraph makes creating any kind of 2D or 3D chart easy.

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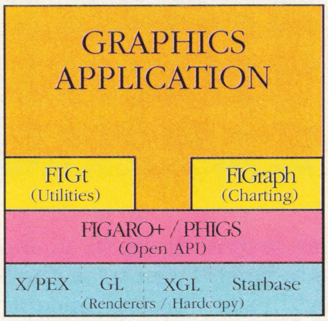

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18 ☐ Personal and business services including medical, legal and accounting
20 ☐ Business services including printing, publishing, advertising, and television/motion picture production and design studios
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SuperMac's Super Color

The new full-color calibration feature of SuperMac Technology's (Sunnyvale, CA) Thunder/24 for Windows family of accelerated graphics boards represents just one of the company's recent product announcements intended to secure its place among the leaders in the fiercely competitive arena of 24-bit color technology (see "Board Games," page 39). SuperMac also introduced a new product family of low-cost, 24-bit color accelerated graphics boards and announced both board families' support for VL-Bus, the new, high-speed local-bus architecture.

Thunder/24's new integral color calibration capability—provided via its SuperMatch Display Calibrator—comes free with the board. According to the company, the new feature ensures that Thunder/24's color information corresponds to on-screen display colors, which users can "lock in," and that the colors on multiple displays will be the same. White point and gamma setting control lets users approximate different lighting conditions under which their color work may be viewed. Additionally, the feature provides autocalibration for Adobe Photoshop for Windows.

Thunder/24 offers a continuous-tone spectrum of 16.7 million colors at resolutions of up to 1152 by 910. The optimized Thunder/24, with a retail price of $1999, provides integral VGA for a single-slot solution and supports various bus architectures, including the new VL-Bus architecture as well as EISA and ISA. According to the company, all three models can accelerate Windows graphics operations by up to 3400 percent. The EISA and ISA versions began shipping in April, and the VL-Bus model is scheduled to begin shipping in June.

While the Thunder/24 family is aimed at professional color graphics users involved in such applications as photo-retouching, creating continuous-tone artwork, and preparing color proofs and separations, SuperMac's new Spectrum/24 for Windows family of accelerated graphics boards, with a retail price of $999, is expected to attract a mass-market audience whose application needs range from business presentations to spreadsheet graphics to publishing layouts to illustrations, according to the company.

Of the Spectrum/24, computer graphics consultant Jon Peddie of Peddie Associates (Tiburon, CA) reports that, at its price and with its custom ASIC design, the board "has proven to be a real performance leader in test after test, and it offers true color at super-high resolution."

As with the Thunder/24 family, the Spectrum/24 family offers a palette of 16.7 million colors at resolutions up to 1152 by 910 and is available for VL-Bus, EISA, and ISA bus architectures—the latter two versions began shipping in April, and the VL-Bus model is scheduled for June shipment. All three versions provide 3M of VRAM. In addition, all Spectrum/24 boards support an optional VGA daughterboard for a single-slot solution.

Support of the VL-Bus architecture allows for faster communications between the graphics applications and the CPU at 132M per second.—*Diana Phillips Mahoney, Associate Editor*

CIRCLE 208 ON INFORMATION CARD

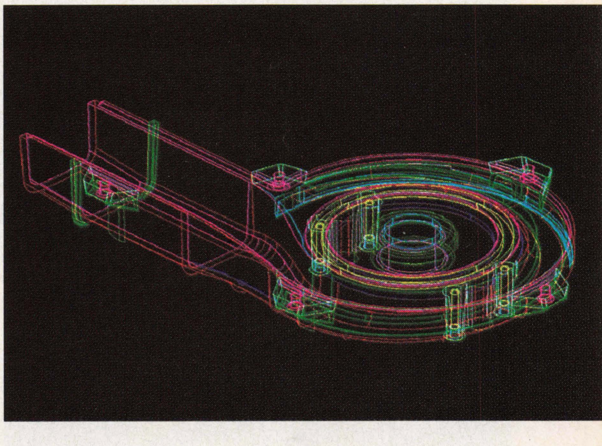
Cadkey Unlocks Creativity

Cadkey 6, the latest release of Cadkey's (Windsor, CT) computer-aided design program, boasts a "revolutionary" integrated, automatic hidden-line removal and shading system, integrates Cadkey Analysis tools, and has expanded data translation capabilities.

According to president and CEO Malcolm Davies, "The shape-recognition and shading technology, called Cadkey Picture It, allows users to quickly visualize their wireframe models interactively within Cadkey 6 in several different ways." These include hidden-line, dashed-line, filled polygon, and smooth shaded images.

The Cadkey Analysis program and the Cadkey IGES translator are now included with Cadkey 6 as part of a single software offering. Analysis is a proprietary software tool based on the Boundary Element Method. Davies says that "it gives users a quick and accurate way to analyze parts." The company explains that Analysis can handle isotropic, homogeneous materials within their specific elastic limits for both 2D and axisymmetric bodies. The bidirectional IGES translator provides for high-quality data exchange between different CAD/CAM systems.

Also bundled with this release are on-line DWG/DXF translators. According to Davies, the ability to read and write DWG and DXF files directly, combined with the existing Cadkey Dynamic Extensions modules and the IGES translator, significantly expand development capabilities.



In addition, the product's new graphical user interface simplifies a variety of functions. Reportedly, Windows-like dialog boxes consolidate information and operations that previously required several menu steps to accomplish.

Cadkey 6 is priced at $3495. It operates on '386/'486 DOS platforms and OS/2 Version 2 and can run as a full-screen DOS application under Windows. It also runs on Unix platforms.—*Laureen Belleville, Associate Editor*

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FEA

TO·THE·CORE

New visualization techniques give engineers a glimpse at the internal behavior of their finite-element analysis models

BY CAREN D. POTTER

Imagine you are sick, but the doctors can't find a cause. They order a lengthy, expensive medical test, and the results show there's nothing wrong—with your skin. The test reveals nothing about your insides.

Change the scenario, and instead of a sick person take a turbine blade that fails after several hundred hours of use. On a computer model of the blade, engineers run thermal and stress analyses. The results, shown in attractive, color-coded displays, indicate that no areas on the model's visible surfaces are reacting in ways that would cause the part to fail. Although the test examines internal thermal and stress behavior, it does not provide a way to view this behavior.

As comparisons go, the pairing of a human body with an engine part has its limitations. But the concept of trying to understand an object's behavior by visualizing only its outer surfaces illustrates a barrier to understanding finite-element analysis (FEA) that has existed for nearly 15 years.

"An FEA results image from 1975 and one from 1989 are very similar," says Richard Gallagher, senior project leader for graphics at Swanson Analysis Systems Inc. (Houston, PA). "In both cases, you'd get a contour plot or continuous tonal display of behavior on the exterior visible surfaces of a structure."

Advances in the broader discipline of scientific visualization have prompted FEA vendors to enhance the visualization capabilities of their own products. "At graphics conferences, we'd bump into people involved in medical and satellite imagery and consider applying what they were doing to the visualization of analysis behavior," Gallagher explains. The re-

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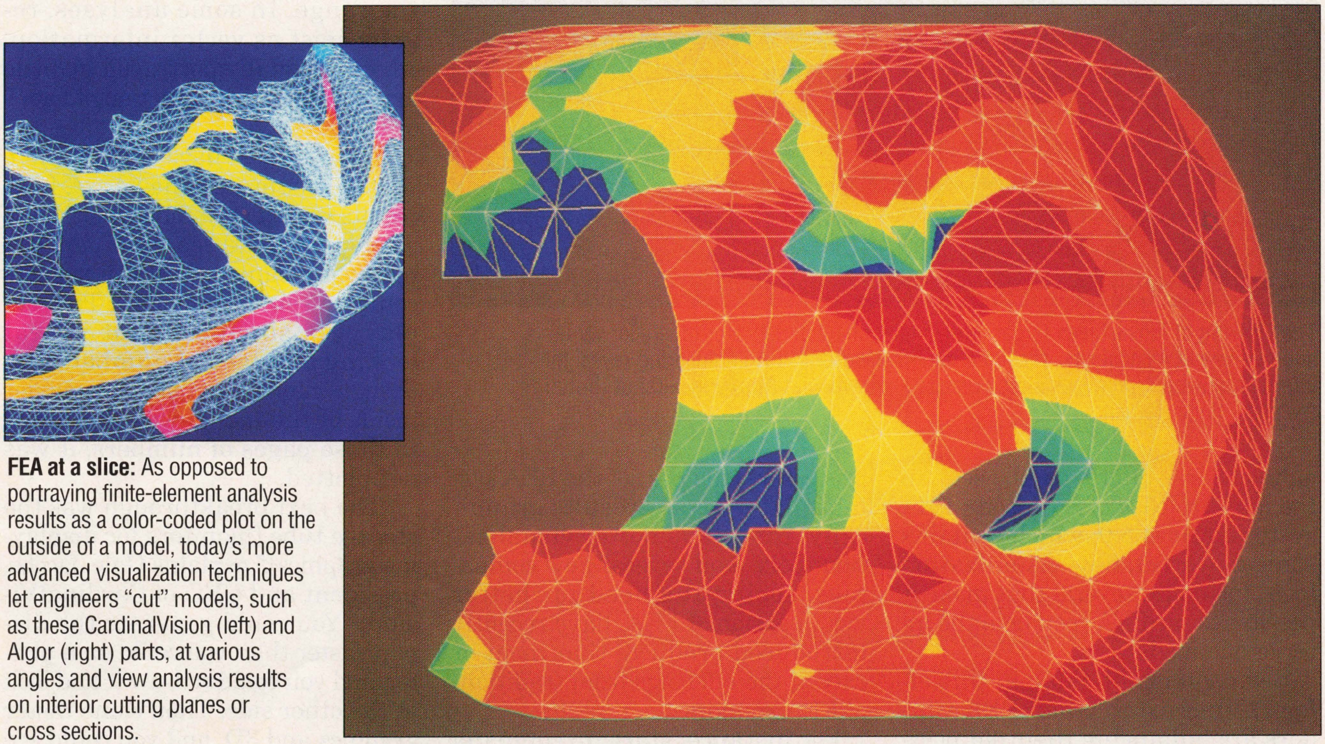
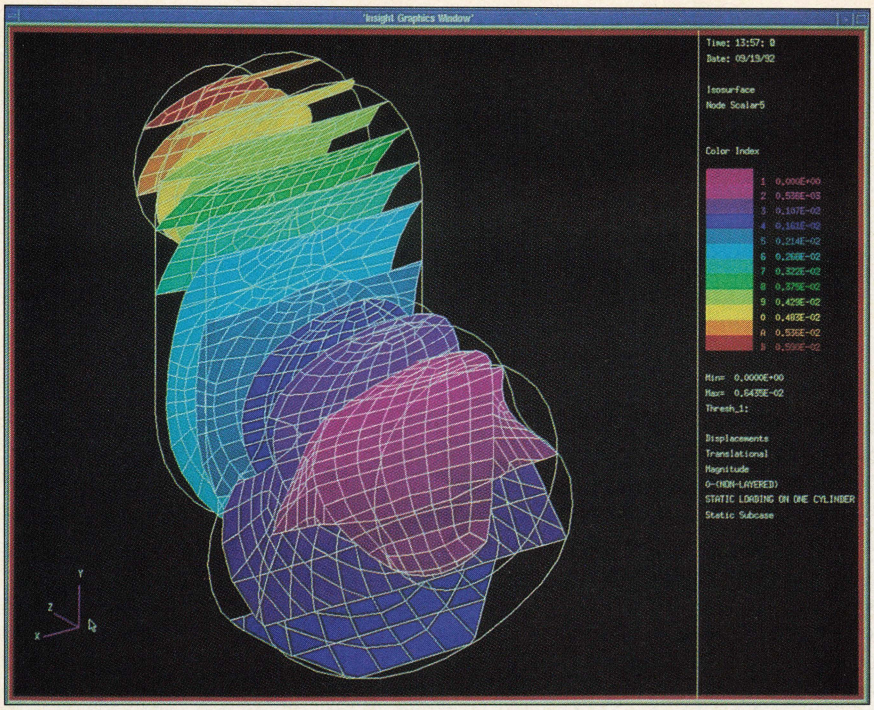
Caren D. Potter is a freelance writer based in Trinidad, California.



FEA at a slice: As opposed to portraying finite-element analysis results as a color-coded plot on the outside of a model, today's more advanced visualization techniques let engineers "cut" models, such as these CardinalVision (left) and Algor (right) parts, at various angles and view analysis results on interior cutting planes or cross sections.



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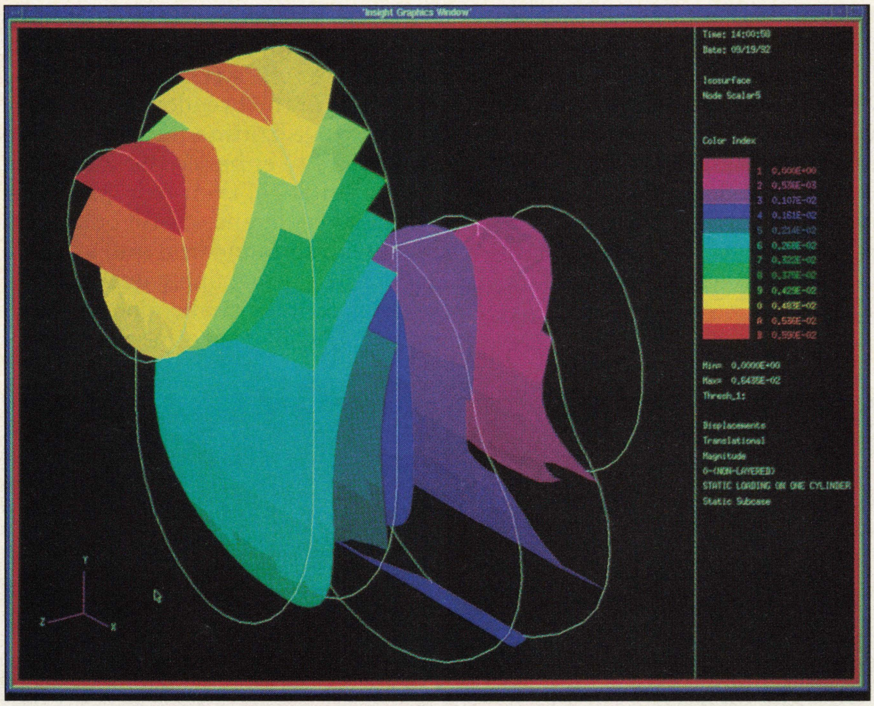

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The viewing of isosurfaces (areas with similar characteristics or of similar value) is another new FEA capability. These Patran images from PDA Engineering reveal the internal values of Von Mises stress results—shown with (top) and without (bottom) the part's finite elements.

sults of these efforts can be seen in the latest release of Swanson's FEA system, Ansys 5.0, which contains some powerful, new visualization tools, including several that make it possible to see FEA results in the interior of a model.

Swanson is not alone in this effort. Other established FEA vendors are enhancing their old postprocessors (the part of the FEA system that portrays results graphically) to include better visualization tools. And several new companies, seeing the need for better visualization of FEA, have recently introduced products that meet or exceed the offerings from traditional FEA vendors.

For instance, start-up company CardinalVision Inc. (Wilsonville, OR) demonstrated an impressive suite of visualization tools at the Autofact show last fall in Detroit. The company intends to sell its C++ object-oriented system to FEA vendors and high-end users as a "library" of functions they can incorporate into their own software. (At press time, the CardinalVision system, called CardinalVision-FEA, was scheduled to begin shipping in June with a single-license price of $9500.) And another company, Scientific Visualization Associates Inc. (SciViz; Concord, MA), offers engineers a visualization system called SciViz REV (Rational Engineering Visualizer), which displays analysis results from most of the major FEA packages.

FEA THEN AND NOW

While most engineers use FEA to determine the stresses and strains on objects, FEA can also be used to study vibration as well as thermal and electromagnetic behavior. FEA results are generated by a portion of the system called the solver, then sent to the postprocessor for graphical display.

A typical display shows a multicolored version of a model, with colors representing different scalar values—red for areas of high heat or stress, for example, and green representing the lower values in the range. In some analyses, results exist as vector information, which is usually portrayed by little arrows indicating direction of forces or loads.

In the earliest days of FEA, there was no postprocessing *per se*. FEA results were just numbers spit out of a computer onto reams of paper. A big break came when the results could be sent to a plotter: The display was simplistic, but it beat looking at pages of numbers. Although information about behavior inside of the model was contained in those pages of numbers, it was not plotted.

"The next breakthrough was the storage tube [monitors for displaying graphics]," explains Gale Jacobs, president and CEO of CardinalVision. "You could generate the display faster than you could on a plotter, and you could redraw it and look at the other side. Then came raster graphics and 3D, and you could see even more by rotating the object or zooming in on a particular area." Still, information about interior behavior was not displayed, and that's where the progress of FEA visualization stalled.

Only recently has it picked up again in a significant way. Packages such as Ansys 5.0 as well as the latest releases from PDA Engineering (Costa Mesa, CA) and Algor Inc. (Pittsburgh) contain an assortment of visualization tools that let users see more than results painted on the outside surfaces of objects.

"Cutting," "slicing," and "clipping" are terms used to describe one such tool. Similar to pulling a wire through a piece of cheese and removing a hunk, a cutting tool gives users the ability to lop off a section of the model to look at FEA results inside.

The clipping process must include an additional step called "capping," however, or the user would see only a blank interior because the postprocessor normally displays just the outside surfaces of the model. Capping, the process of painting results onto the newly exposed interior surface, has been challenging for FEA vendors to provide.

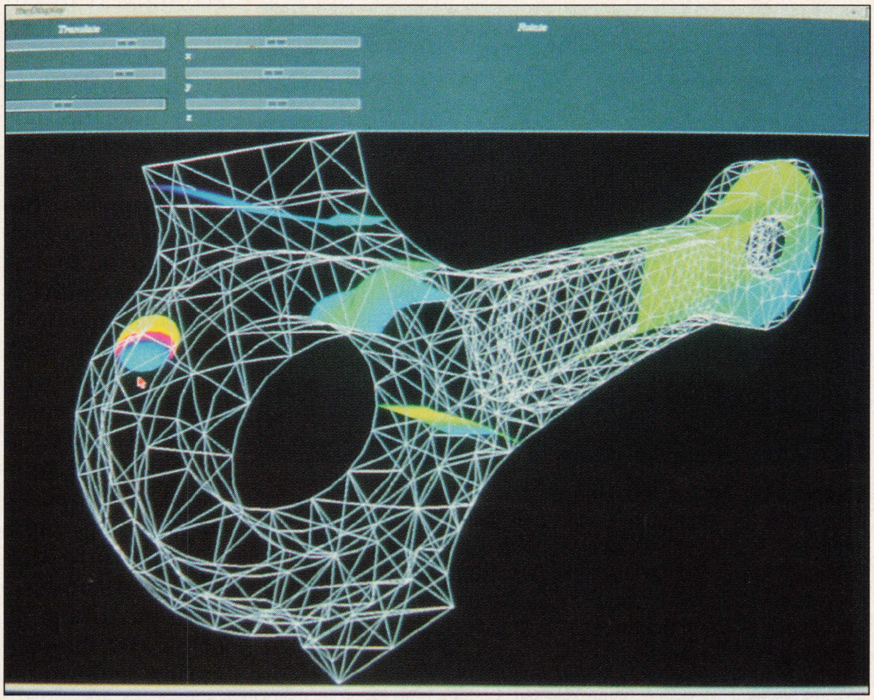
"Clipping is not computationally difficult," says Swanson's Gallagher. "It can often be done in real time in hardware. Capping, on the other hand, is the process of computing and displaying results that lie on the clipped plane. It's a little trickier because the system has to compute the values where the plane passes through."

THE CUTTING EDGE

Two factors differentiate the cutting tools of the various FEA vendors that offer them: whether they can be positioned anywhere within the model and how long they take to display results. Some older postprocessors offer a cutting function that is limited to cutting away only portions of the model that lie on the face of elements (slice off some cheese only where lines are drawn). More advanced cutting tools let the user make the cut anywhere in the model and are often said to provide "arbitrary" cutting or slicing capability.

As for speed, most postprocessors, even the newer ones, do not offer a cutting tool that works in real time. As Gallagher claims, "The major FEA programs like ours operate in an environment where you issue a command, and the system goes 'thinkety, thinkety, think' and spits out a picture. But the trend is moving toward the ability to poke and prod the model in real time. CardinalVision is further along that path than the major finite-element codes are."

In contrast to most postprocessors, CardinalVision-FEA lets a user move a cutting tool through a model and watch the colors on the cut surface change in real time. This is a significant step forward for FEA visualization, and one that FEA vendors will eventually have to match.



Multiple visualization tools for exploring the interior of an FEA model exist with the CardinalVision-FEA package. In addition to demonstrating a cutting plane and the presence of an isosurface (in multiple pieces), this model contains a graphical "data probe," the multicolored ellipsoid on the left side of the object. The probe changes shape in accordance with tensor (pulling force) information.

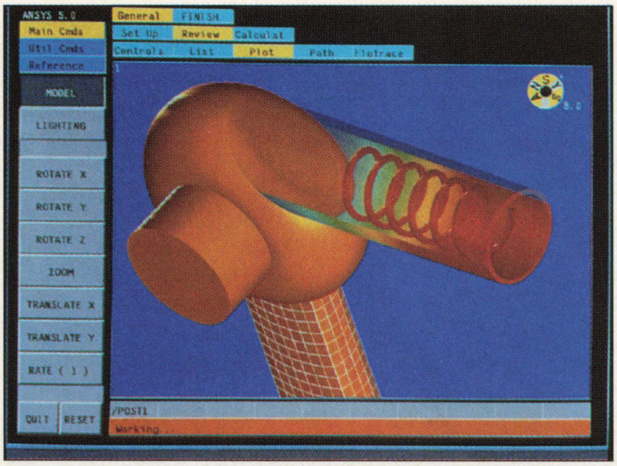
How important is the ability to cut into a model and see the FEA results within? Very important, says Craig Ronald, senior machine design engineer at The Gleason Works (Rochester, NY). "When you have a complex structure, you're not sure what's happening inside," he explains. "You could calculate it by hand—decide what element you want to know about and go find it in your output file. But you don't do it unless it's real important. It's a headache."

Gene Rosenbaum, senior engineering specialist and project leader at Analex Corp. (Brook Park, OH), points out that the old way of looking only at surface results is adequate in two instances: for a quick look at a model's behavior and for objects that are very thin. "Surface visualization capabilities are fine for designers," he states. "It's simple, it's easy to understand, and they don't need more detail because they're looking at major problems for redesign." And for something with a very thin skin, such as the Cruise Missile, Rosenbaum says, "You don't have changes in stress from the outer skin to the inner skin because it is only ½- to ⅘-inch thick. But for something that is 2 to 4 inches thick, you're concerned with how the stress is going from external to internal regions."

Another advanced visualization tool that some postprocessors now include is the ability to view isosurfaces. Isosurfaces are areas with similar ("iso") characteristics—for example, all regions of a model at which the temperature rises above 100 degrees.

"In the old days, people created a plot on a Calcomp plotter to show isolines, similar to a terrain map," explains Jacobs of CardinalVision. "That only looked at the outside of the structure. Now we can see regions inside the model which have similar stress, temperature, or other characteristics. This data has always existed in the solvers, but we haven't been able to see it," he says.

An interesting complement to the isosurface feature is the ability to display a second variable on the isosurface itself. For example, suppose you wanted to look at an isosurface showing temperatures higher than 100 degrees. If that was all you wanted to see, you could tell the system to color that region red. But if you also wanted to know stress values at all of the places at which the temperature was higher than 100 degrees, instead of a red isosurface the system would present a multicolored isosurface with different colors indicating different stress values.



Smooth shading and reflectance as well as other techniques for enhancing models now also form part of an engineer's FEA visualization tools. With Swanson Analysis Systems' Ansys 5.0, for example, this hair dryer nozzle has been made to appear translucent so that engineers can see the heating coil and the thermal contours displayed on the bottom half of the nozzle.

A "data probe" represents another advanced visualization option that (of the commercial FEA vendors) currently only CardinalVision provides. The data probe is designed to display tensor quantities, a difficult concept to describe as it is to display.

"Most sophisticated parts have tensor fields," explains Jacobs. "At any given point, there are forces pulling up and down, left and right, like a balloon being stretched. For every individual point on the design, up to seven numbers represent tensor quantities. How do you go about showing that?"

CardinalVision has opted to use an ellipsoid (the "data probe"), which changes shape as it passes through the model. As it moves, it becomes larger and smaller, rounder and flatter, representing the forces pulling on it. In a demonstration provided by CardinalVision, the data probe, as it reached the end of a crankshaft, resembled a pancake, indicating no stresses from top or bottom but strong pulling from the sides. Like an isosurface, the data probe may be painted with colors that represent a second variable, such as temperature. "It would let you see that, in an area where the model is being pulled very strongly, it might also be very hot," says Jacobs.

The ability to view more than one FEA variable simultaneously (a multivariate display) is a useful visualization tool. A data probe or an isosurface shown in conjunction with stress values can lead to a greater understanding of an object's behavior. It is also possible to go beyond a multivariate display and combine FEA results with other 3D visualization techniques such as model shading and translucency. Ansys 5.0 offers some nice functionality along these lines.

When it comes to displays of multiple variables or displays containing multiple visualization methods, FEA vendors face competition from what might be called general-purpose engineering visualization systems. These include the Data Visualizer from Wavefront Technologies Inc. (Santa Barbara, CA), Fieldview from Intelligent Light Inc. (Fairlawn, NJ), AVS from Advanced Visual Systems Inc. (Waltham, MA), and a handful of others. Many of these visualization systems offer functionality similar to that contained in newer FEA postprocessors; in fact, the makers of these systems were ahead of traditional FEA vendors in bringing "advanced" visualization capabilities to engineers. The primary advantage of these general-purpose systems is their ability to display combinations of analyses.

"Someone might choose the Data Visualizer over a traditional FEA postprocessor because it can deal with a wider variety of data types," says Michael Wilson, engineering market manager at Wavefront.

"Combining multiple analyses in a single postprocessor, that's the real leading edge," adds Steve Legensky, president of Intelligent Light.

MacNeal-Schwendler Corp. (MSC; Los Angeles) offers a fluid-structure interaction code, MSC/Dytran, which serves as a good example of the need to display multiple data types. Dytran is used to analyze automobile air bags, bird strike on aircraft, and other applications involving both fluid and structural calculations. The company recommends Wavefront's package for visualizing Dytran results because, as Peter Mendoza, ETD (Explicit Transient Dynamics) marketing manager for MSC/North America, says, "Data Visualizer is the only software we've found that can simultaneously display time-dependent isosurfaces, gas dynamics calculations, and the kinematics of a crash dummy."

HIGH TIME FOR BETTER FEA

Regardless of whether these advanced visualization tools come from traditional FEA vendors or from general-purpose visualization software vendors, the important thing is that they are finally here. One of the reasons they took so long is that much FEA consists of structural analysis, which didn't drive development of sophisticated visualization tools.

"Many stress problems with composite materials happen at the edges or at the surfaces," says Mark Kenyon, manager of technical marketing at MSC. "It's the same with metals. Cracks form on the outside because that's where they interact with the environment. However, there are many other engineering problems where things happen inside."

Adds Gallagher of Swanson, "As computing power has increased, more people are doing geometrically complex and materially complex analyses with interior 3D behavior. But analysis techniques are also becoming more sophisticated, in part because the visualization capabilities we're developing are letting more complex behavior be observed." *CGW*

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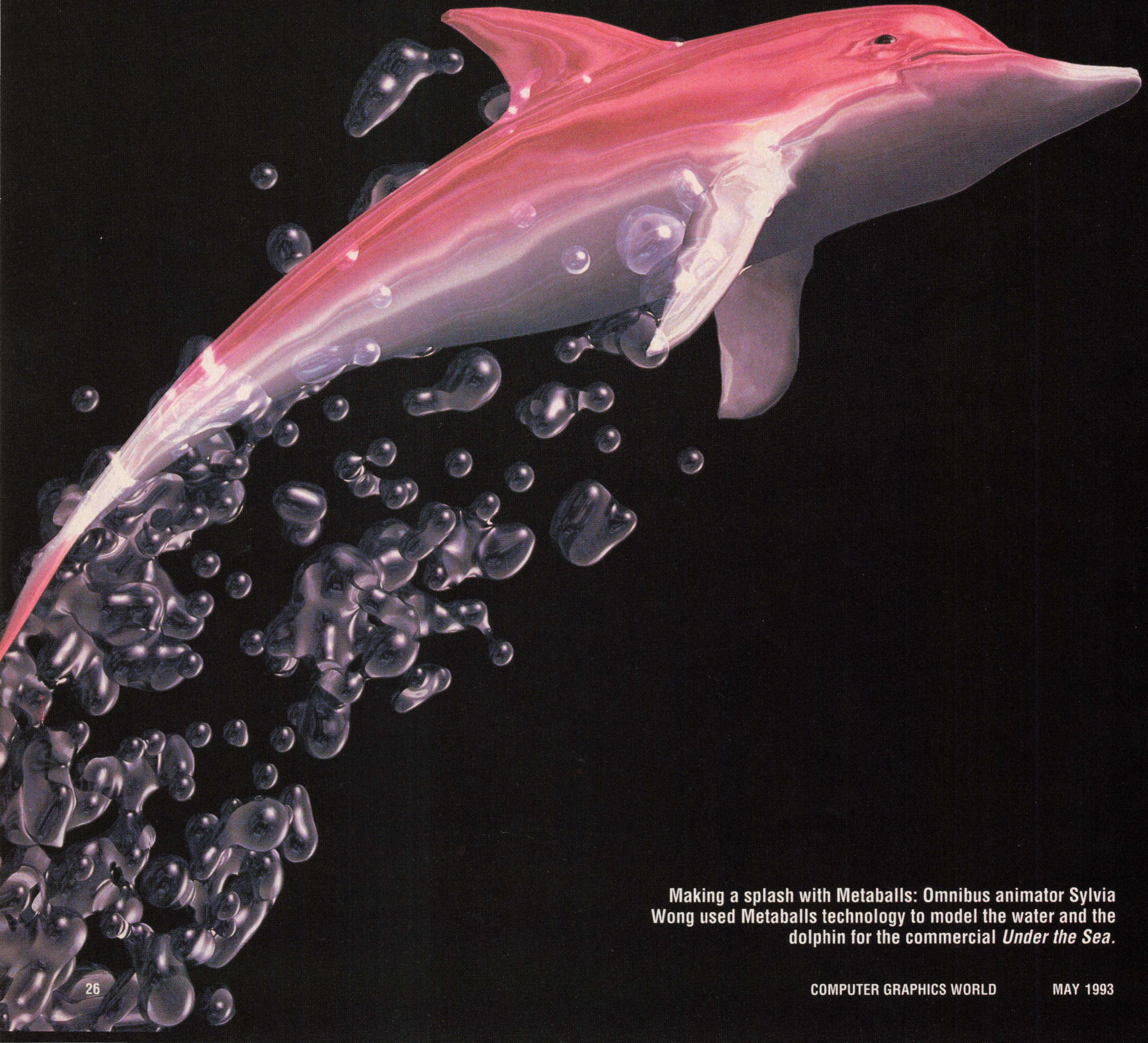
THE MAGIC



Making a splash with Metaballs: Omnibus animator Sylvia Wong used Metaballs technology to model the water and the dolphin for the commercial *Under the Sea.*

OF METABALLS

BY GAYE L. GRAVES

A new computer technology adds realism to organic models

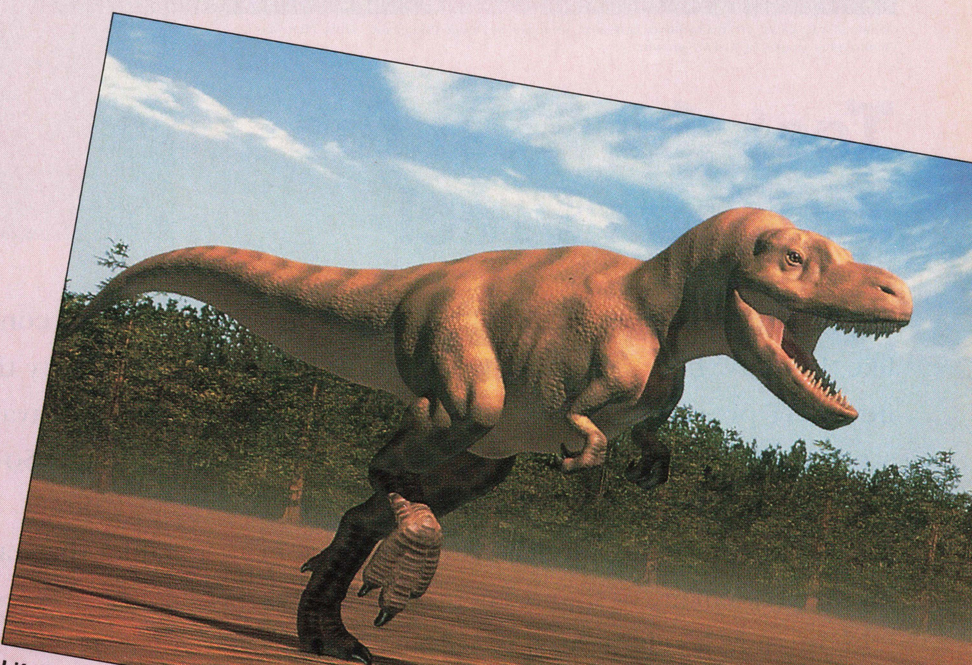
The release of Steven Spielberg's newest movie, *Jurassic Park*, is still more than a month away, but already speculations about the film's box-office potential are running rampant. The movie focuses on a remote island that genetics researchers have turned into a theme park populated by dinosaurs. But besides having a compelling theme, a big reason why the film is expected to be so successful, say observers, is that the computer-generated dinosaurs in the film look incredibly lifelike.

Although specific details about how the dinosaurs were created were still sketchy at press time, the word in computer graphics animation circles is that the dinosaurs owe their realistic features and movements to a computer technology called Metaballs.

Metaballs technology is based on a relatively new computer graphics modeling primitive that gives shape to all sorts of realistic, organic-looking creations, from dinosaurs to sea cows and from pouring liquids to human beings. One of the most famous uses of the technology before *Jurassic Park* was for the short HDTV animation *Dino Tours*, shown at the 1992 SIGGRAPH Electronic Theatre and produced at HD/CG New York by some of the early users of the technology. Like *Jurassic Park*, this animation stars lifelike dinosaurs created using Metaballs technology. As the ponderous behemoths stride through the jungle, their skin, which looks soft and spongy, alternately becomes taut and then sags across the creatures' joints.

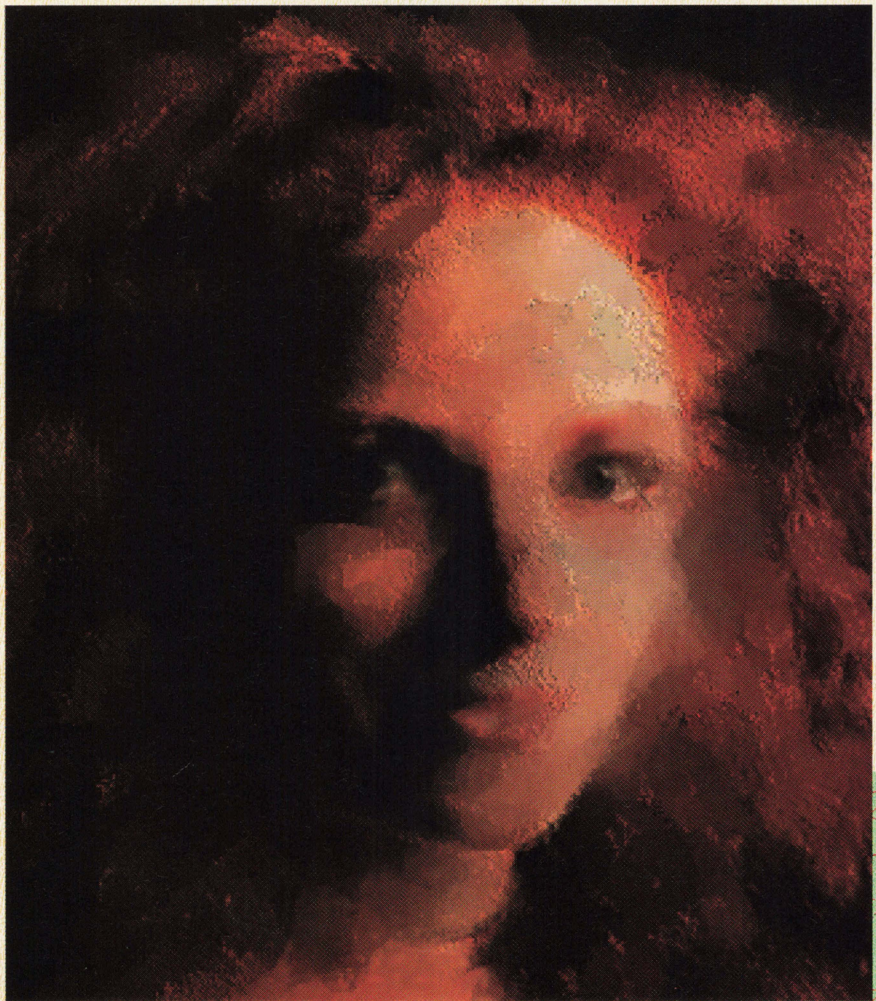
While these are examples of relatively recent uses of Metaballs, the technology was actually developed in 1982 by Koichi Ohmura, who was at that time an assistant professor at Osaka University in Japan, and his computer graphics group. At the same time, reknown US computer scientist Jim Blinn was developing a similar concept. Blinn called his primitives "blobby molecules."

But whether they were called blobby molecules or Metaballs,



Lifelike Metaball dinosaurs roamed the Earth in the HDTV video *Dino Tours*.

Gaye L. Graves is a freelance writer based in the San Francisco Bay area.



"Rembrandt Redhead" created by Rhoda Grossman, using Fractal Design Painter and Adobe Photoshop. Original photography by Joel Meyerowitz.

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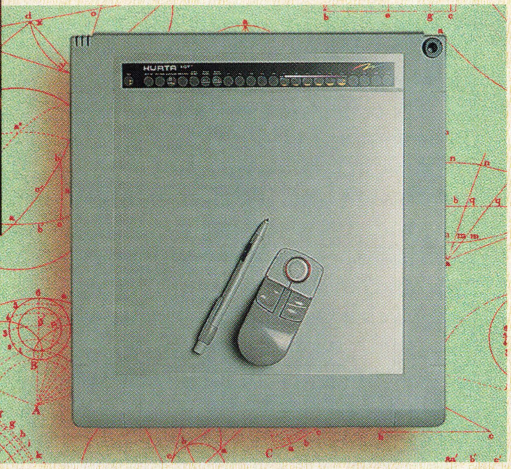

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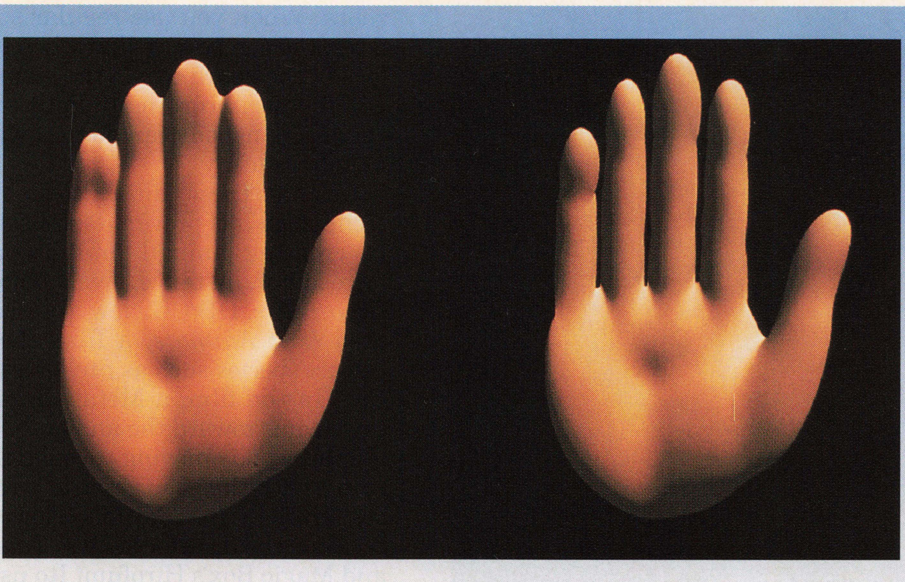


Keeping fingers distinct: Super Metaballs, or Metaballs with eccentric distributions, give animators control of the direction in which the Metaballs fuse. Therefore, when used to model the human hand, super Metaballs help keep individual fingers distinct.

these smooth, complex, curved forms presented a major problem in the early days in that they were extremely difficult to specify and edit, prohibiting wide use of the technology. Then in 1986, Eiji Takaoki developed the MetaEditor, which could be used for visualizing a Metaball's topography.

Later, in 1988, he founded Meta Corp. Japan to make the MetaEditor available commercially. Although the MetaEditor has been available in Japan for several years, it was not marketed in the US until early 1992. Since then, companies such as Thomson Digital Image (Paris and Los Angeles), SoftImage (Quebec), and Side Effects Software Inc. (SESI; Toronto) have incorporated Metaballs technology into their software, and some vendors have developed software modules that work with Metaballs to further enhance the technology's capabilities.

HOW METABALLS WORK

Metaballs come in several different shapes and sizes, from spherical to ellipsoidal, and each has its own unique set of attributes—size, color, weight, and degree of fusion—all of which can be user-controlled. In one form, for example, Metaballs can behave much like drops of mercury floating through space. Picture what happens when two droplets of mercury touch. They slowly start to fuse, their characteristics merging and blending. Because Metaballs join smoothly and gradually, rather than abruptly and at right angles, they can be used to animate the flow of liquid or to simulate the smooth curves of organic figures.

This fusing ability also means that it takes a smaller number of Metaballs to approximate a smooth, curved form than it takes to create the same form with polygons. Generally, the fewer the number of primitives, the smaller the data file. Therefore, files for Metaball models are typically at least two to three orders of magnitude smaller than those modeled with polygons.

Kim Davidson, a principal at Side Effects Software Inc., points as a prime example of these capabilities to the human torso that is often seen in MetaEditor product literature. That model of the human torso was created using 43 Metaballs. "If you get [digitized data] for that much of a human torso," he says, "you'd be talking probably about 10,000 polygons, and [the edge] wouldn't be as smooth if you zoomed in on it. With 43 Metaballs, you can get super close on an edge and it is still super, super smooth. Those 43 Metaballs are perfect."

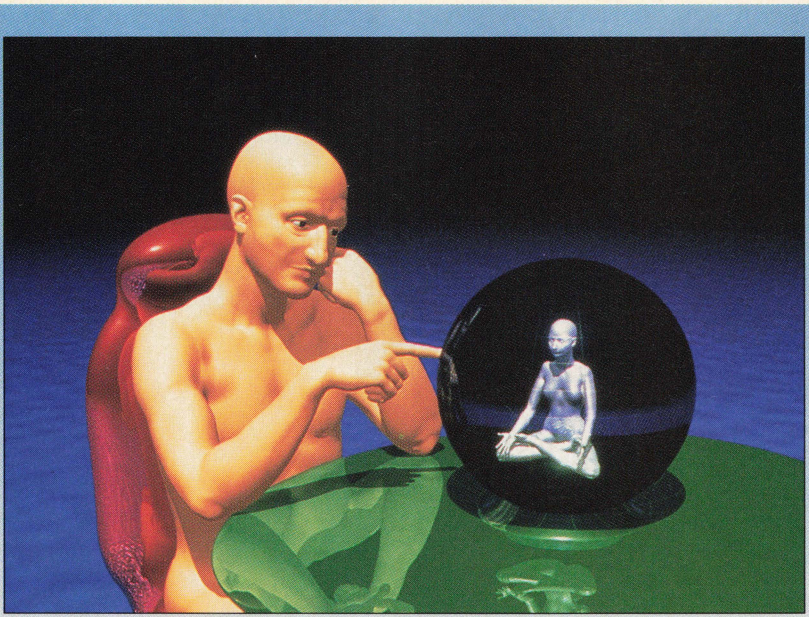
The Metaballs structure operates on a theory of distributed density. The center, or core, of the Metaball has the greatest density. The value of the core's density, or "weight," decreases toward the Metaball's outer edge, or "effective radius." The visible size of the Metaball, called the "threshold radius," is determined by the effective radius and the weight. The user must choose to specify either one or the other when specifying a Metaball. If the weight is increased, the threshold radius also increases.

Weight also influences how a Metaball affects other Metaballs in proximity. As two Metaballs start to fuse, the value of the weight becomes smaller, while the effective radius becomes larger. Thus, as the Metaball gains weight, it becomes "harder" and fuses less easily.

Meta Corp.'s MetaEditor makes it possible to preview and edit the final shape of an object being modeled with Metaballs. The user can check his work in three ways: by using the interactive modeling mode to gain real-time alterations of the shaded model, by using the same mode with a wireframe model, and by using various contour trace operations, which overlay portions of the Metaball model with contour maps. Alas, the MetaEditor is responsible only for the modeling. The CPU-intensive rendering of the models requires additional software.

The MetaEditor can convert Metaball data into two Metaball data formats. For example, SESI's Prisms/Action software supports direct Metaball rendering from the MetaEditor. The MetaEditor also converts the Metaball model to various software formats of polygon data for rendering. The transformed polygon data can then be exported to Wavefront, Autocad, or TDI Explore software, for example.

The current version of MetaEditor can also create "super Metaballs," or Metaballs with eccentric



The humanlike Dr. Metakos, a commentator in a weekly Japanese television series called *Wooface*, was produced using a special animation system to synchronize the movements of his mouth with his voice.

distributions—that is, density distribution that is off-center. Eccentric distributions permit selective control of the directions in which Metaballs fuse. In some instances, this feature is of utmost importance. Take the human hand, for example. If one were modeling the human hand using Metaballs technology, the Metaballs used in the fingers would be so close that they would be apt to fuse. However, using the eccentric distribution of super Metaballs, one can adjust the density of the core and make specified Metaballs lean away from each other, thereby keeping individual fingers distinct.

Like the MetaEditor, V-Clay—a product developed by Magic Box of Beverly Hills, California—also addresses certain problems inherent in Metaballs. For instance, Metaballs depend upon ray-traced rendering, which requires labor-intensive redesign for integration into an existing environment. Also, Metaballs are incompatible with surface-based animation techniques. V-Clay enables users to manipulate ellipsoid (superquadric) and non-ellipsoid (hyperquadric) shapes as well as provides the option of using ray-tracing or the faster scanline algorithms, which allow the use of graphical instructions in RISC-based systems for real-time Metaball rendering. Also, V-Clay is compatible with existing surface-based systems, so, for example, a fish modeled with V-Clay can "swim" naturally in a tank composed of surface-based models. And it supports mixed-mode scene rendering, including Metaballs as well as polygons, patches, and spline surfaces.

Late last year, Magic Box announced a sub-licensing agreement with SoftImage to incorporate V-Clay into Version 2.6 of the SoftImage Creative Environment. "We call it Meta-Clay," says SoftImage's Mark Petit, "because it is just like working with clay!"

DEALING WITH TEXTURES

While certain issues with Metaballs technology have been addressed by various software vendors, one problem which thus far has defied a solution is that of handling fixed textures. Although there are ways to get around it, everyone agrees that this issue creates a significant hurdle in using Metaballs. Says Petit, "This is implicit in all Metaball technology: When you use Metaballs, you cannot use textures. That's why you see all these blobbies in chrome, gold, or water."

Adds SESI's Davidson, "The whole surface is changing and can be separating in an animation. How would you ever put a map on that?" For example, imagine animating a zebra. When you use regular surfaces, you can be sure that when the legs of the zebra move, the stripes will follow. According to Petit and Davidson, nobody can do that with Metaballs today.

Despite these difficulties, the technology has proven itself useful in creating animal and human forms. For instance, even before *Dino Tours*, HD/CG New York created *Lost Animals*, a film about extinct species such as Steller's sea cow. In the film, a Metaballs sea cow swims toward the audience, its blubbery body moving through the water with the easy grace of a real sea animal. In addition, Noriaki Kaneko, the director of *Dino Tours*, and Magic Box's Hirofumi Ito used 500 Metaballs to realistically recreate the human body for the NHK TV series *The Universe Within*.

Another highly visible user of Metaball technology is Japan's Links Corp., which ranks as one of the five largest computer graphics production companies in the world. Links, which has its own in-house computer graphics software suite, has the flexibility to create graphics using either Metaball or polygon-based software.

Examples of Links' work include a Terminator 2-like chrome villain shown in the opening titles for the Fuji TV action/adventure series *Ucchan Nanchan No Yarunara Yaraneba!* as well as a character created for a Nissan commercial that is half car and half man.

The car/man character is particularly interesting in that it demonstrates Links' ability to combine Metaball and polygon elements in the same figure. The Nissan car/man's "body" was created with Metaballs to achieve his humanlike movements, while his more rigid "head" was created using polygon-based software.

Links also used the technology to create animation for a theme park simulator ride. The Fujita IGT (Inter Galactic Travel) ride takes audiences on an intergalactic flight, where they pass through ancient ruins complete with Metaball waterfalls and come perilously close to viscious, underwater Metaball dinosaurs.

Another Metaballs user is Sylvia Wong, an animator with Omnibus, a computer animation facility in

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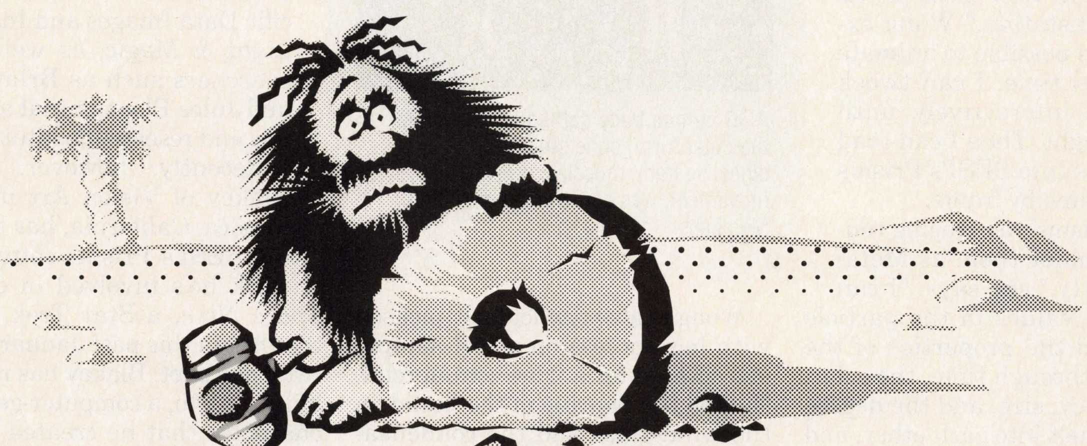

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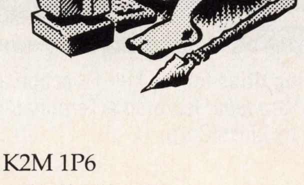

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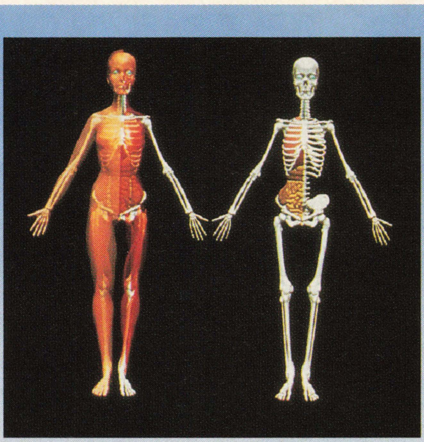
CIRCLE 13 ON INFORMATION CARD

Japan. Wong has experimented with the Metaball option to SESI's Prisms software and has been using it in conjunction with Omnibus' proprietary particle system software, Particus. This program can control massive amounts of points, enabling Wong to model and animate natural behavior that is too complex to handle by other means.

"Since I can view these points on my workstation," Wong explains, "it is possible to animate in near-real time. I can tweek the values interactively until they look right. Then I can read these points into SESI's Prisms software frame by frame.

"I use Prisms' ray-tracing renderer to render them as Metaballs directly," she says. "I can specify the values in the particle system and the properties of the Metaballs through time, the color, transparency, size, and the degree that they melt into each other, and so on. I can also read in a series of deforming data whose surface can act as the generator of points."

Wong used this last technique to animate a dolphin for a commercial called *Under the Sea*. "I let the dolphin be the source and let its motion determine the spray of particles, which were ray-traced as Metaballs to look like water," she explains.



A 3D human body database, including the outer form, bone structure, digestive tract, muscles, cells, and movement, was constructed with 8000 Metaballs.

Wong is also particularly pleased with her success on a test sample she created for a wine commercial. "I liked the pouring of the liquid on the wine glass and the condensation," she says. "The condensation has very nice movement. You wouldn't even know that it was computer-generated.

"That's the nice thing about combining particle systems with Metaballs," she adds. "The Metaballs make everything flow together so it is liquid-like, and the particle systems are really easy to control because they are just points."

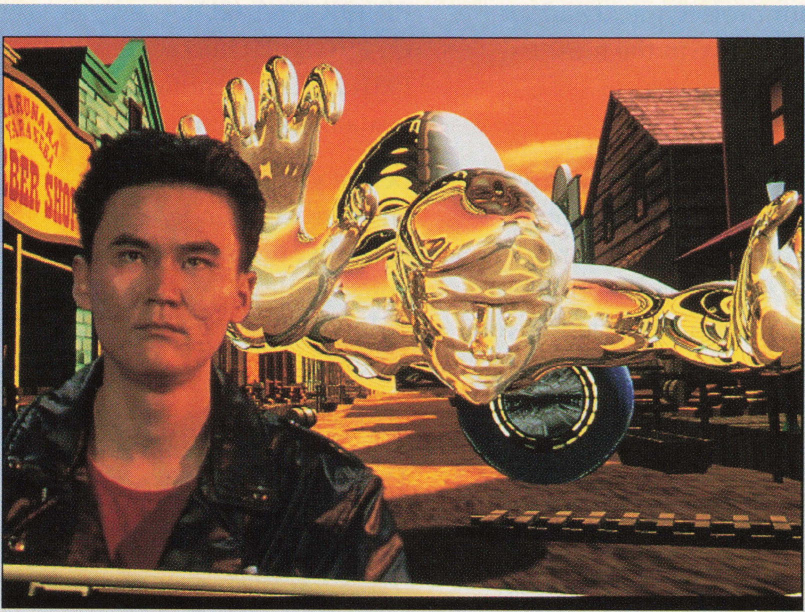
Metaballs, blobby molecules, or just soft objects have enjoyed a popularity in Japan similar to that of morphing in the United States. The Japanese have embraced the technology and have been its most dedicated developers. In the United States, the primary users of Metaball-type primitives have been computer animation facilities, such as Pacific Data Images and Industrial Light & Magic, as well as researchers such as Brian Wyvil and Jules Bloomenthal at academic and research institutions.

Recently, however, Dennis Blakey of Vision Art in Santa Monica, California, has been using SESI's Prisms software for work he's involved in on *Deep Space Nine*, a Star Trek spin-off that began this past January with a two-hour pilot. Blakey has responsibility for Oto, a computer-generated character that he created using a mixture of Metaballs and morphing techniques.

CREATING OTO

"According to the story," explains Blakey, "Oto is a liquid character, so it was a perfect thing for the blobbies." In one scene in the pilot, for example, Oto appears in the form of a handbag; the handbag, which contains gold bars, is put into a locker. "I morph the bag into a blobbies bag and then have all those blobbies falling down under gravity against the bars and rolling out of the locker," says Blakey. "The next shot we cut to shows all the blobbies coming out of a grate in the wall under the locker, and it flows down onto the floor and forms a puddle. I switch over to a polygonal model by morphing over at that point," Blakey adds.

Although there is still a long way to go in the world of Metaballs, interest in the technology is growing. And although more Japanese companies have a head start in the technology, Metaballs are catching on everywhere. More and more "mainstream" software packages are now able to import polygonized Metaball data, making them available to all sorts of users. And perhaps most importantly, users love them. *CGW*



The opening titles for the Fuji TV action/adventure series *Ucchan Nanchan No Yarunara Yaraneba!* featured a Terminator 2-like chrome villain created with Metaballs by Links Corp.

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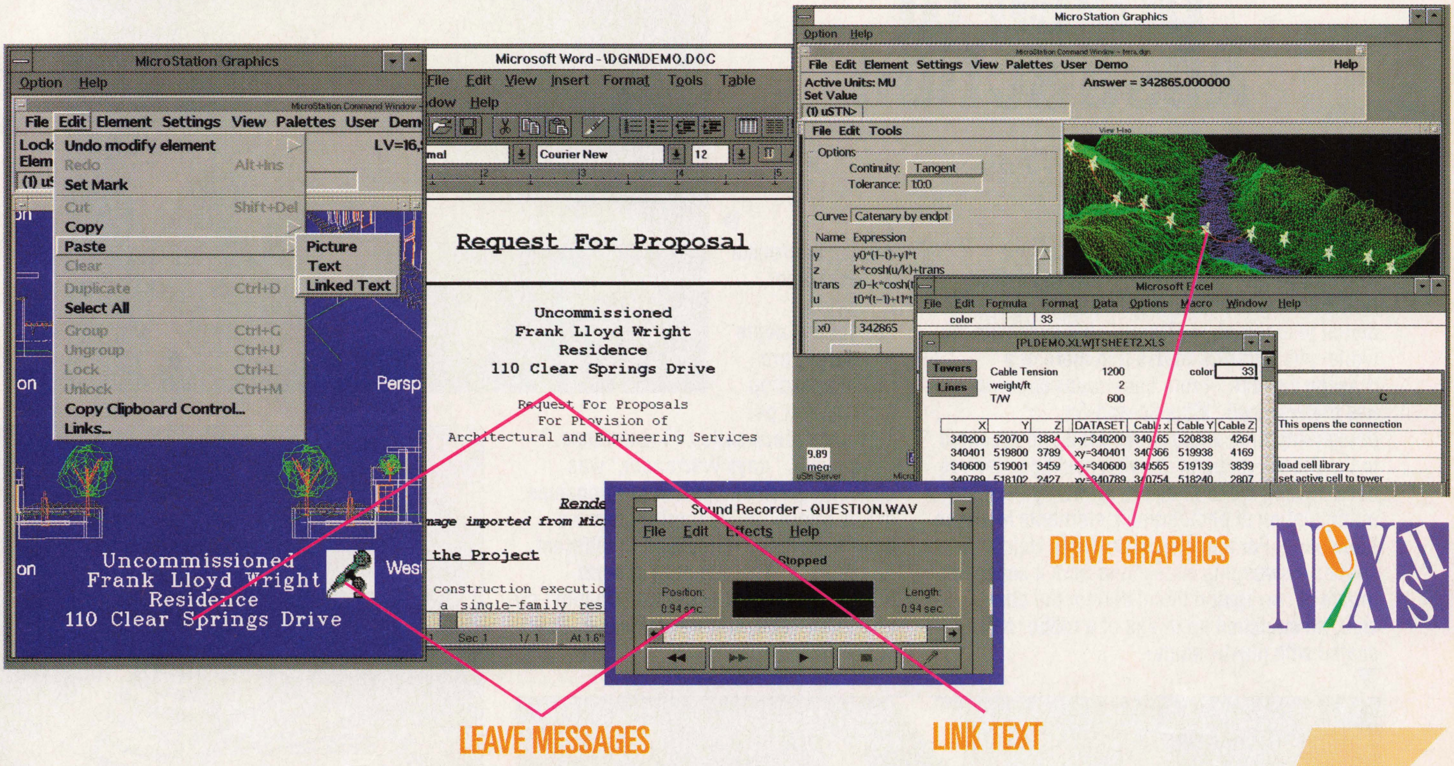

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340401	519800	3789	xy=340401	340366	519938	4169
340600	519001	3459	xy=340600	340565	519139	3839
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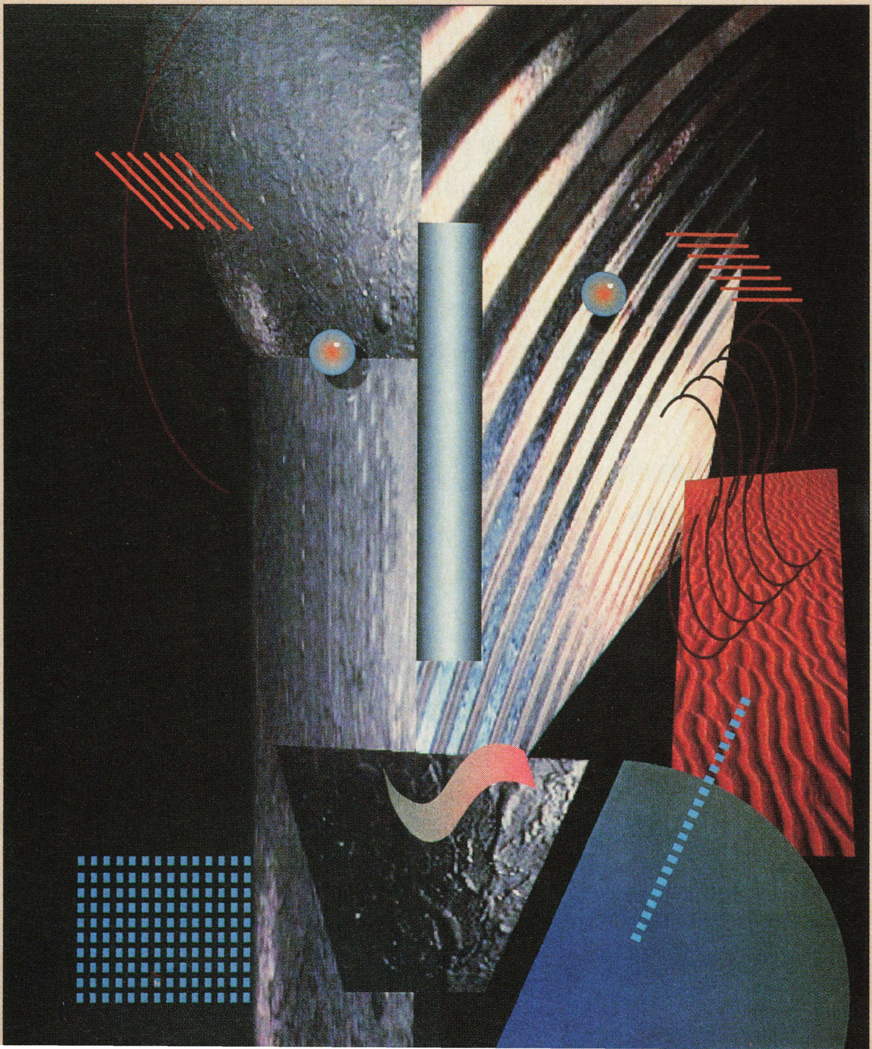
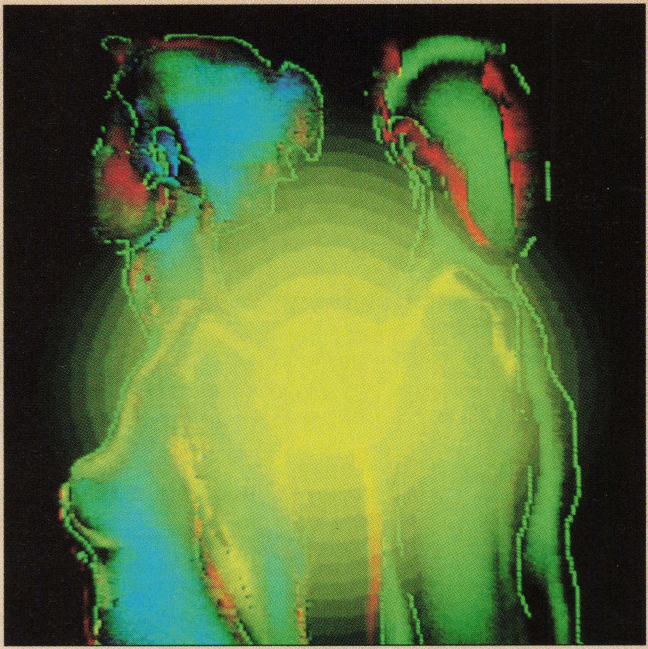
INTERGRAPH
Solutions for the Technical Desktop

Driven to Abstraction

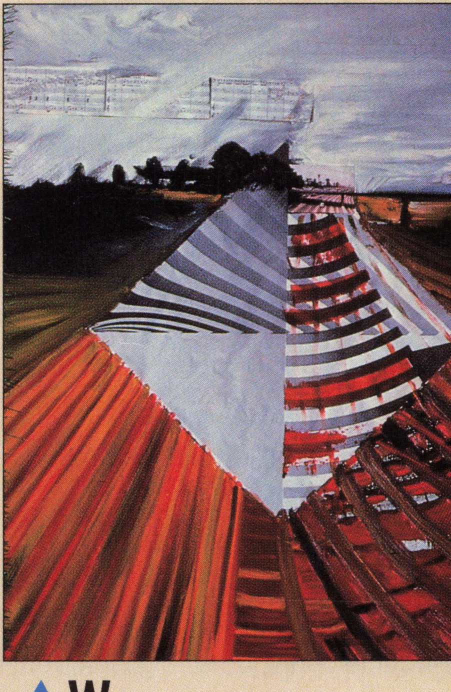
By Gary Pfitzer

"What I'm trying to do," says artist and University of Oregon (Eugene) professor Mike Holcomb, "is to combine drawing software with digital photography software—but even with the digital photography, to use it in more of a drawing context." From this *modus operandi* has materialized "Miss So-and-So," a personality who, while assembled and accented in the Aldus Freehand drawing package, derives her arresting facial structure primarily from the manipulation of photographic elements in Adobe Photoshop. For one side of the face, Holcomb shaped a sweeping cheekbone from a scanned image of corrugated metal and for the other side, he stretched an image of a rubber ball coated with plastic solder.

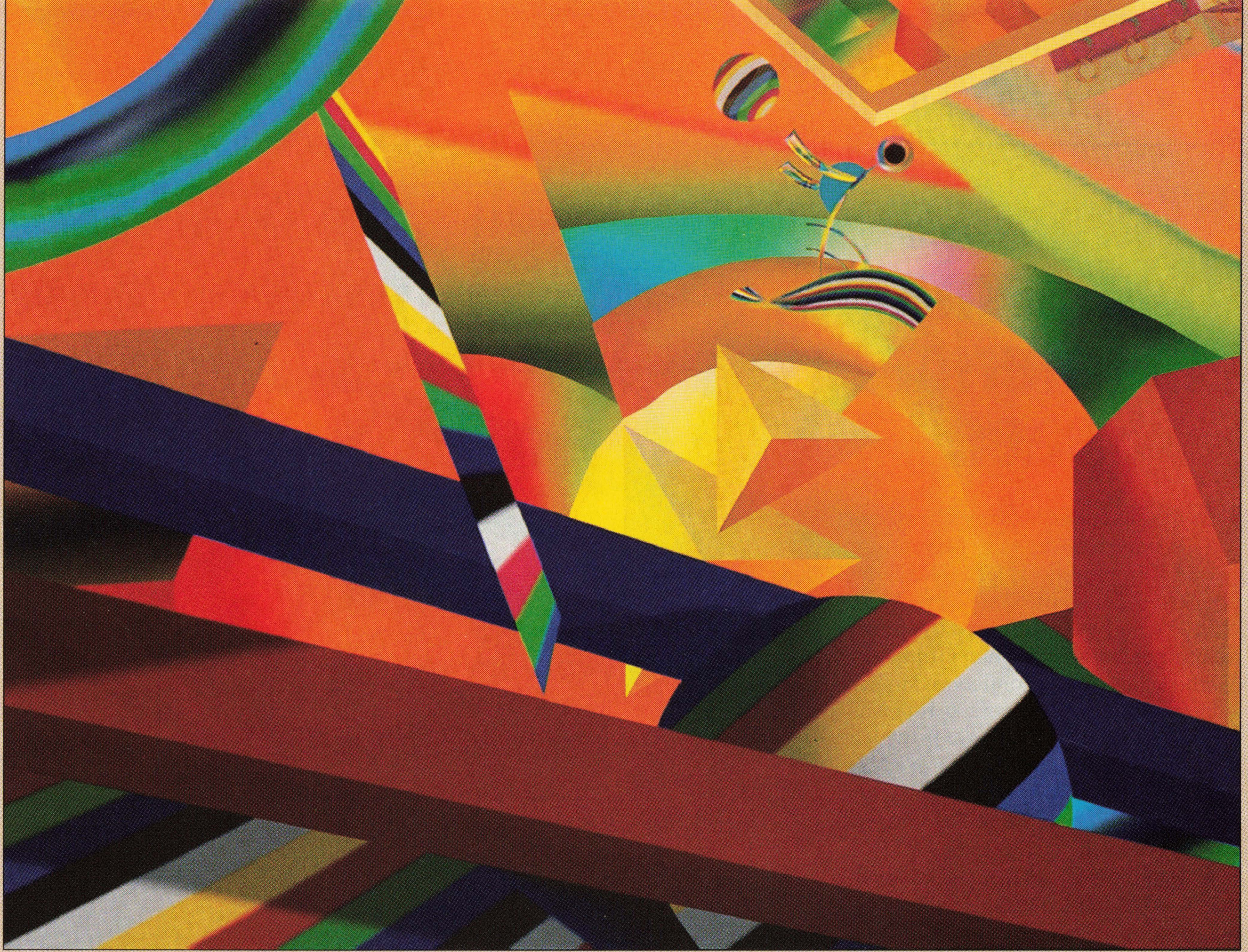




Patrice Warrender of Sebastopol, California, designed "Couple" as a large, projected backdrop for a theater performance piece called "Touchdance." "The piece," says Warrender, "was about the push and pull of relationships. In this image, for example, there's a couple, but they're focused in different directions." The owner of several Amigas, Warrender created "Couple" on an Amiga 1000 with Newtek's Digi-Paint software.

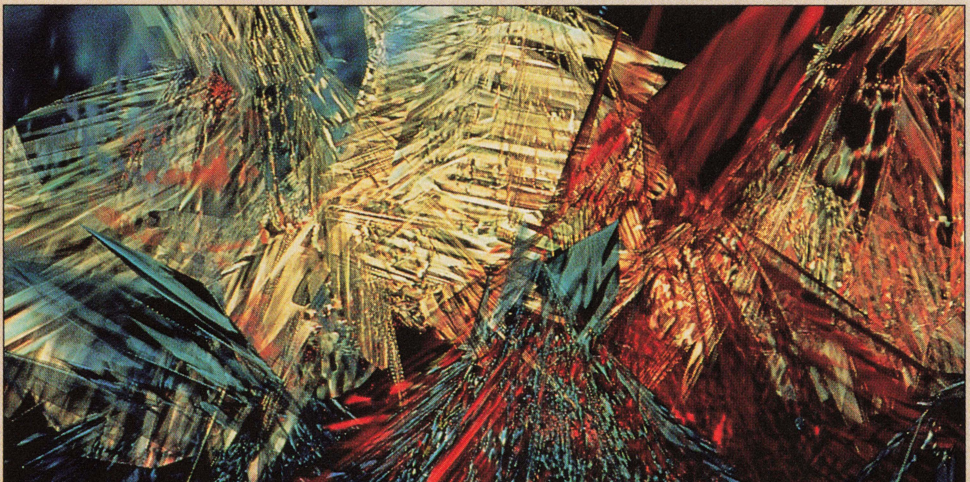


Wyoming—with its ostensibly infinite, wide open spaces occasionally slashed by a lonely highway—provides inspiration for Anna Ursyn, an artist who teaches aspiring educators at the University of Wyoming (Laramie) how to incorporate computers into their art curricula. "I'm interested in the rhythmic repetitions of natural structures, such as vegetation, that are juxtaposed with patterns and manmade construction," says the Warsaw native. Her mixed-media piece, "From the Village to the Big City," represents a combination of Fortran programming on a DEC VAX machine, Versatec plotting, and a photosilk-screening technique.



Represented by The Williams Gallery

Wynne Ragland's "Kandinsky's Carnival" contains a playful tribute to Russian abstract painter Vasily Kandinsky with its inclusion of a little stick figure catching a ball, reminiscent of Kandinsky's 1936 painting "Composition IX, No. 626." Beyond that, however, Ragland, a creative director with Media Management (Norcross,GA), a multimedia consulting firm, engaged in some creative texture mapping with the color bars from an NTSC test pattern. En route to his end result, he used Truevision's Tips, Ron Scott's HiRes QFX, and CrystalGraphics' Topas packages running on a '486-based IBM PC clone.



"Inscape #3" forms part of a series of images by Seoul-based artist Hye-Kyung Kim. "The title 'Inscape' means 'inner scenery'—inner feelings or psychological state," says Kim. "Inscape #3" is actually an Alias 3D image created out of simple, primitive objects that grew in complexity as Kim worked interactively on a Silicon Graphics workstation with material definitions, textures, colors, and lighting. "I was not only concerned about each effect but also the relationships between elements and objects to get a good gestalt," she adds.

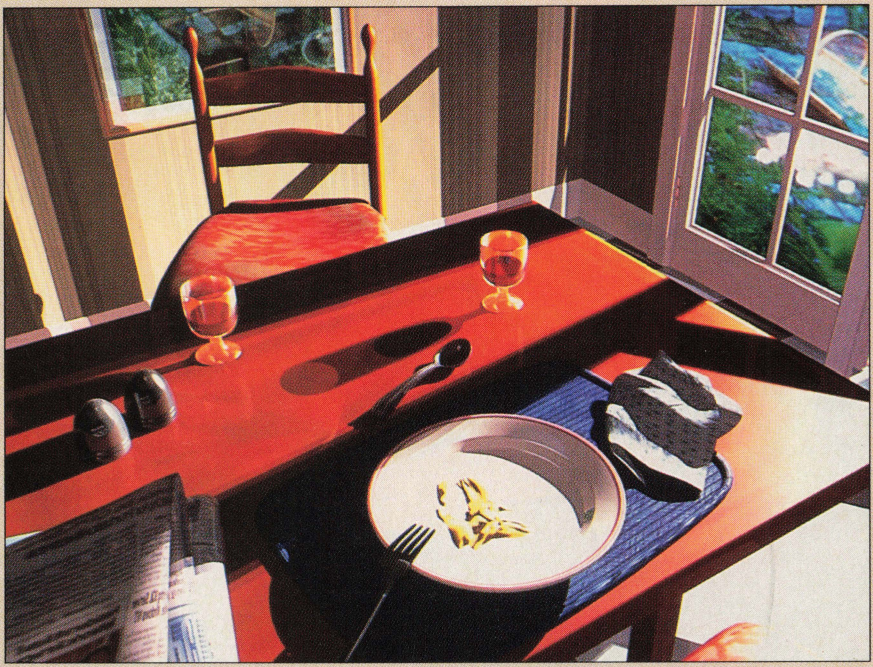
"Timeless Moments in Interior Space"

What you see before you on these two pages is half of Kyeng-Im Chung's thesis for an MFA degree from Pratt Institute (Brooklyn, NY). The native Korean used the thesis assignment to explore her interest in 3D modeling. She was influenced in her subject matter by past work in Korea as a housekeeper—a job through which she became attuned to the cycle of life as reflected in the cleaning up, messing up, and cleaning up again of the various rooms of a home.

Chung chose to create an A ("cleaned-up") and B ("messed-up") version of four different rooms: a bedroom, a dining room, a bathroom, and (as a sign of the times) a computer studio. Pictured here are both versions of the bedroom and the messed-up versions of the dining room and the bathroom. "I wanted to express the importance of seemingly ordinary moments in our daily lives, which are more important to our lives than they seem," she states. "I wanted to recognize timeless moments in interior space."

These modern-day genre pieces benefitted from Chung's access to a Silicon Graphics workstation running software from Toronto-based Alias Research Inc. Chung used Alias' ray-tracing feature for those rooms that contained reflective elements but turned to ray casting when soft shadows and the establishing of a "moody" quality took precedence over sharp reflections.

In Chung's imagination, the inhabitants of her rooms might be a typical middle-class couple. "Because of the recession," she adds, "their means have become modest, and their lives have become a little tiresome." But Chung would not force her interpretation upon anyone. "The photo-realistic still image," she explains, "has tremendous power to give aesthetic and unlimited imagination to audiences."—*GP*



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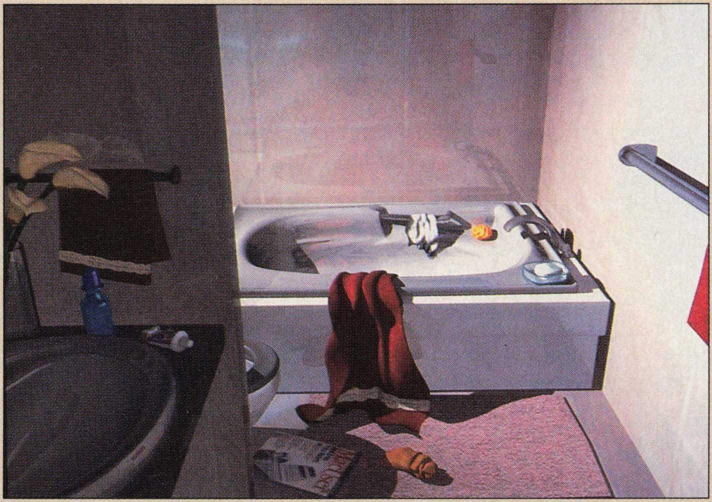
Dining Room B (Ray-Traced)



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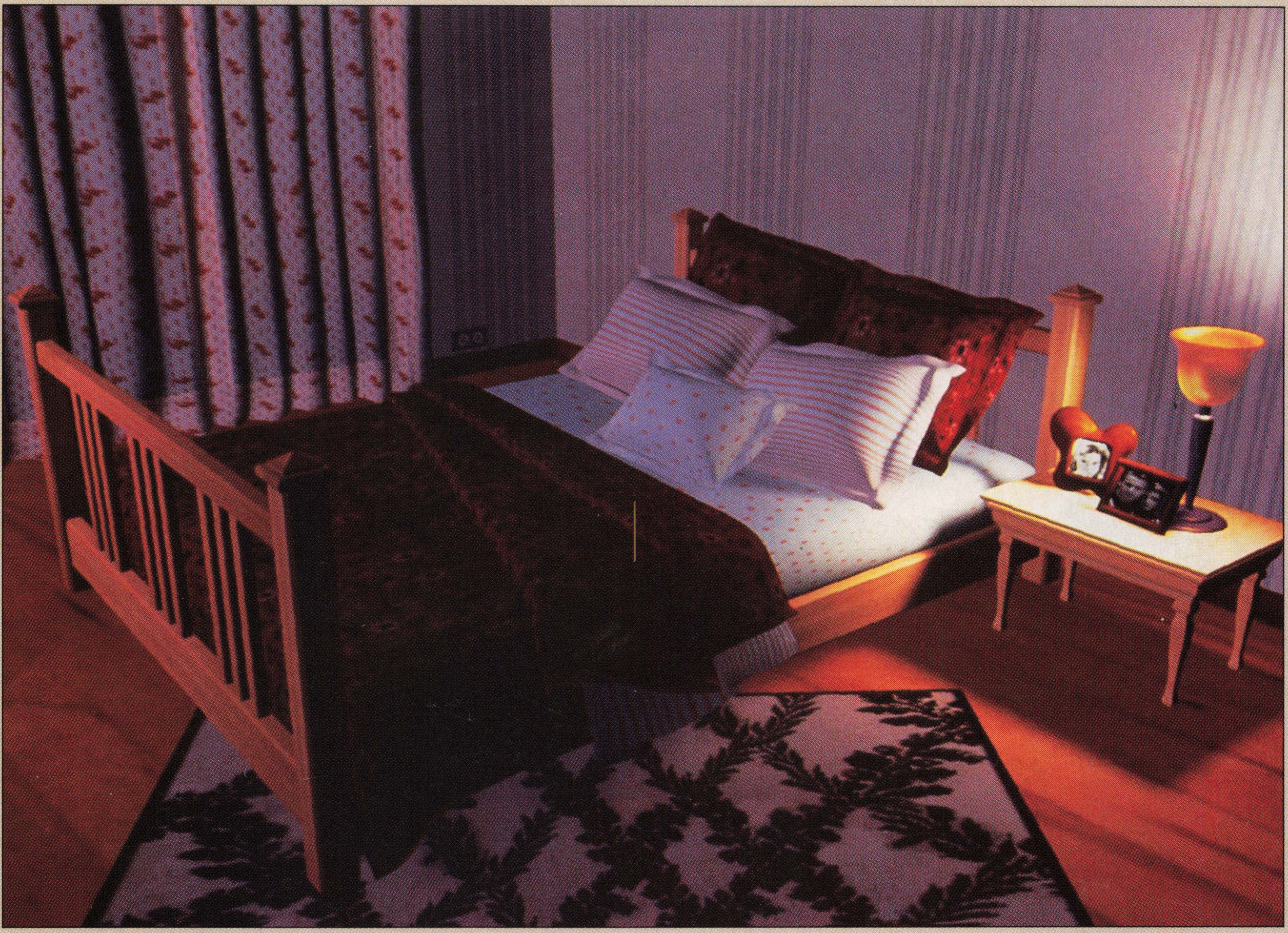
Bathroom B (Ray-Traced)



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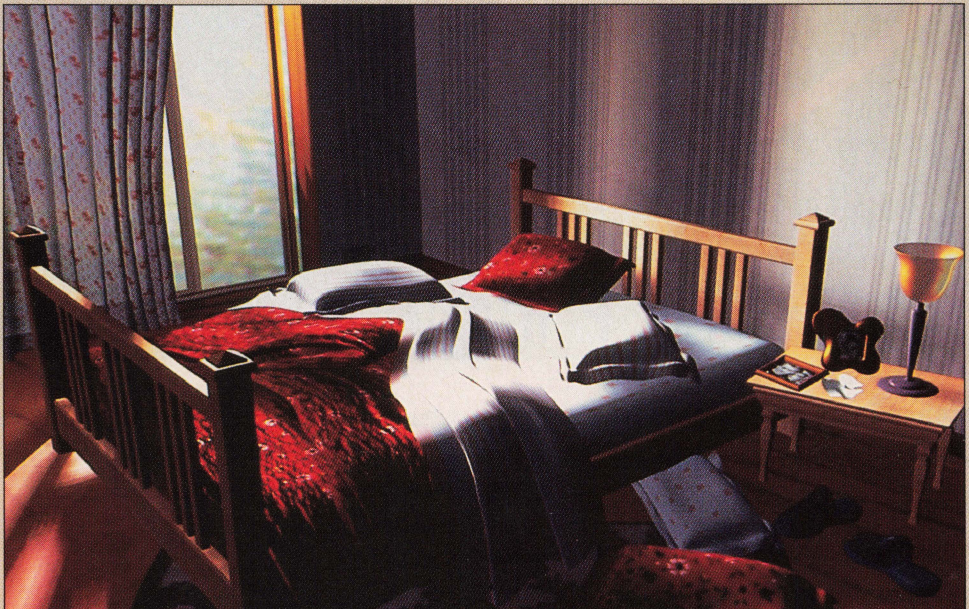
Bedroom A (Ray-Cast)



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Bedroom B (Ray-Cast)

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CIRCLE 16 ON INFORMATION CARD

Board Games

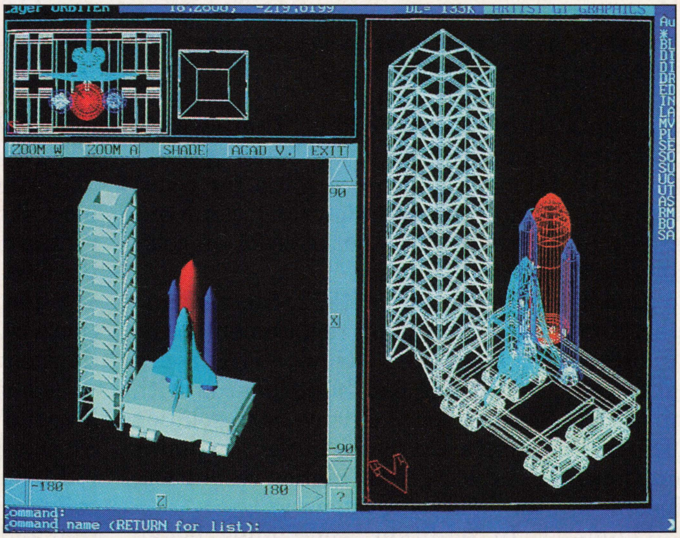
As 24-bit color becomes standard for PC graphics boards, manufacturers struggle to "one-up" their competitors

By Barbara Robertson

It happened so fast, it might have escaped your notice: 24-bit color is now considered standard fare for PC graphics card manufacturers. Most of the cards that support VGA, the PC display standard for mass-market software, offer 24-bit color. And since the introduction of Windows 3.1 last fall, most display cards that support Windows offer 24-bit color.

Indeed, most graphics cards now being introduced support both 24-bit color and Windows—whether or not they also support other standards, such as those for CAD software. "There are 175 manufacturers of VGA cards making 431 different products," says Jon Peddie of Peddie Associates (Tiburon, CA), a company that tracks and tests PC-based boards. "Plus, there are an additional 105 non-VGA boards for PCs. I'd say 95 percent support Windows and all support 24-bit color in at least 640-by-480 resolution."

For the most part, the range of cards supporting 24-bit color are priced within users' reach. At the lower end, color display cards that support 24-bit color at 640-by-480 resolution sell for less than $200. For graphics professionals, cards with coprocessor chips and 24-bit color at high resolutions (1152 by 910, 1280 by 1024, and edging higher) sell for less than $1500. And, says Erik Blom, a senior analyst of PC graphics and video hardware for IDC (Framingham, MA), "There's a lot to choose from in the $400 to $800 range. People are keeping their color monitors and upgrading them with display cards. Because Windows 3.1 is 32-bit capable, people will jump several generations of cards." (He expects to see monitor upgrades next year.)



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The 3D real-time utility of Artist Graphics' new 3D graphics controller, the Xj1000, allows users to quickly rotate wireframes, Gouraud-shade an object, and link these capabilities with Autocad AME.

"There seems to be zillions of players," says Grant Wickes, product manager for Picture Publishers, a Windows-based image-editing program from Micrografx (Richardson, TX). "I wonder how they exist."

How *do* they exist?

"You have to be the first one out with a product, you have to market very hard, and in four to five months, you better have something else out there," says Sandy Flora, director of marketing for Numerical Design Inc. "Less than a year ago we introduced 24-bit color at 1024-by-768 resolution. Now that's trickling to the mass market." NDI's current plans include supporting 24-bit color at 1600-by-1280 resolution. "The whole industry is in a major price war," Flora says. "This is going to be a very bloody spring. Consumers are getting products almost free. But," she acknowledges, "it's really very confusing to consumers."

Indeed. How does one choose among 400 or so products? Some consumers, it seems, have put their faith in benchmarks—a tendency some board manufacturers have been quick to exploit. Arguably, the primary benchmark for display cards that support Windows has been Winbench, developed by Ziff-Davis Labs, which reports "Winmarks." "At [fall] Comdex, people were walking down the aisles yelling out 'What's your Winbench number?' and people in the booths would shout out the answers," says IDC's Blom. But, he cautions, "Consumers see the numbers and go 'Wow'; they look at the price tags and say, 'That's incredible'; but

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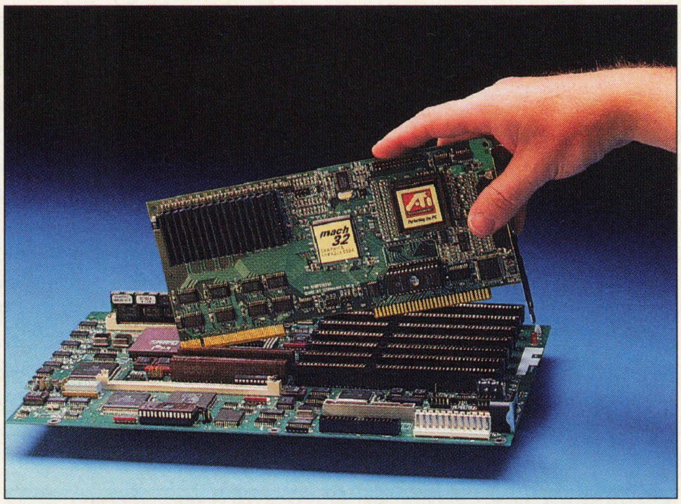
Barbara Robertson is West Coast senior editor of *Computer Graphics World.*

some board companies are putting far too many resources into optimizing for benchmarks."

Peddie agrees. "The problem was that vendors found ways to cheat with the 2.5 version of Winbench, which was popular until [fall] Comdex. Boards were made 'benchmark-aware.' " Whether that optimization was of any use in actual applications is dubious. For example, Number Nine played the benchmark game for a while, one-upping its competitors by optimizing the Windows drivers on its cards specifically to get higher numbers. "We started to cache everything, and we could advertise 40 million Winmarks," says Patrick Lucci, director of marketing for the company. Then Number Nine got off the treadmill. "The big loser in the benchmark wars is the user," says Lucci. "We finally said we'll just go our merry way. It's a lot of nonsense at a certain level."


One of the many players in the 24-bit color game, ATI Technologies offers its Graphics Ultra boards.

Now, rather than spending R&D dollars optimizing Windows drivers to get numbers that look good in ads and bar charts but result in miniscule productivity gains for users, Number Nine is developing other features—a 2K-by-2K virtual desktop, for example, that, given a fast machine and enough RAM, could cut the time it takes to move from an application in one on-screen window to another.

Meanwhile, new benchmark tests are being developed by firms such as Peddie Associates (WITS, free via the WUGNET forum on CompuServe) and Microsoft (Winstones) that may provide more useful numbers. And Winbench has been upgraded as well (to version 3.1). Will those be of any more help? Maybe. Until then, "It is possible for a person to buy a very, very low-cost, seemingly high-performance graphics card," says Peddie. "But if you don't do your homework, you're going to get burned."

So now, some homework. To understand something of what's going on in this wild circus of events, it helps to backtrack to 1991 when IBM introduced the "XGA" display standard and made the public aware of 15- and 16-bit color. Sierra Semiconductor soon introduced a low-cost "HiColor" replacement for the old (1987), much-cloned IBM 6-bit VGA DAC (digital-to-analog converter). And that DAC was cloned by other companies. "Then Orchid, STB, Genoa, Tom, Dick, and Harry offered HiColor capability on their cards," says Peddie. "There wasn't much software, but some applications began gearing up for color. And then, Windows 3.1 came out with 32-bit potential so 24-bit color became a reality."

In the fall of 1992, Sierra came out with a 24-bit replacement for its 16-bit DAC. "Now VGA board companies can build boards with 24-bit color at 640-by-480 resolution using a 1M frame buffer," explains Peddie. "To get higher resolution, they add more memory."

In addition, companies began adding Windows accelerators to the cards. And with color, performance, and a graphical user interface now in place, software companies began moving the popular graphics programs from the Mac to PCs.

"There might not be a color publishing business yet [on PCs]," says Steve Blank, SuperMac Technology's vice president of marketing. "But the supposition is that there is one emerging, and if price [of systems] is an issue, we're eliminating it." Other board companies are quick to take notice as well.

"Soon all the major Mac publishers will be cross-platform," says Andrew Fisher, vice president of communications for Hercules Computer Technology Inc. Fisher believes 24-bit Windows cards can now be divided into two categories: those that appeal to a general market with 24-bit color as an aspect and those that concentrate on 24-bit color. Hercules has products in each category. You could also categorize the products by many other variables, such as bus, price, speed, type of chips, type of memory, or type of graphics accelerator.

Peddie, whose business it is to analyze the offerings, creates order from the chaos with four categories. For each, he provides a list of the top five vendors with the most volume sales. First, entry-level cards. These display cards sell for between $100 and $200, have little or no Windows acceleration, but use a 24-bit DAC and offer "maybe a little help for raster operations." Market leaders in this category include Boca, Diamond, Paradise, STB, and Video7. The "Tom, Dick, and Harry" "no-name" cards are most likely to be found in this category. Cards in both this category and the next offer 24-bit color at 640-by-480 and less color at higher resolutions. At the highest resolutions, they tend to use interlaced screens.

Peddie's second category includes low-end cards priced in the high $100 to $200 range that offer slightly higher performance. They typically include full "BitBlT" acceleration and maybe a hardware cursor and line-drawing acceleration. (BitBlT, pronounced "bit blit," stands for bit block transfer. It's used to copy a bit-mapped image—for example, to move a Windows screen from one memory location to another.) Many of these cards use the 805 graphics accelerator from SE Inc. and are sold for general office use. Companies with the most sales in this category, according to Peddie, include Cardinal, Diamond, Hercules, Orchid, and STB. The no-name clone vendors, however, are beginning to shift into this category.

In what Peddie refers to as the "high-end VGA" category are cards that cost between $300 and $500. These tend to use the S3 928 chip, offer all the acceleration in the second category, plus some can use VRAM. With 2M or more of RAM, these offer 800-by-600 resolution in 24-bit color and higher resolution (and usually noninterlaced screens) with lower color depth. Sales leaders in this "professional systems" category are ATI, miro Computer Systems, Number Nine, Numerical Design Inc., and Video7.

Peddie's final category represents the widest price range—$500 to $2000—and the least volume sales. These cards, which are targeted at the prepress, document imaging, and CAD markets, tend to include graphics coprocessor chips of their own design as well as those from Brooktree, TI (34020), Weitek (P9000), and Intel (i860) and digital signal processors. Many of these cards support 1280-by-1024 resolution at 24-bit color and offer 3M or more of VRAM. Some of these are nonVGA. Sales leaders in this category, according to Peddie, are Artist Graphics, Matrox, SPEA, SuperMac, and VideoLogic.

With these categories in mind, following are some rules of thumb for selecting a display card. First, not all cards support all software drivers. Most Windows cards support VGA; some support Autodesk's ADI drivers and MicroStation and other CAD programs.

Second, the least expensive cards tend to produce interlaced displays at high resolutions and noninterlaced screens at lower resolutions. Noninterlaced is better. With interlaced screens, the display must be drawn twice—one set of lines from top to bottom, then the in-between lines are filled in from top to bottom. This process can produce a jumpy-looking image on screen. (A vertical refresh rate of 50Hz or lower suggests an interlaced screen.)

In general, the higher the vertical refresh rate, the steadier the image appears. The Video Electronics Standards Association (VESA) recommends 72Hz or better for a flicker-free display. As for speed, the resolution and color depth offered by a card depend on the amount of on-board memory. You can fit a 24-bit, 640-by-480 resolution or an 8-bit, 1024-by-768 image into 1M. With 2M you can get 24-bit color at 800-by-600 resolution; with 3M you get 1024 by 768. At 1280-by-1024 resolution, you need a little more than 4M. Of the two types of RAM used on display cards, VRAM is faster (and more expensive for card manufacturers to buy) than DRAM because it can handle data coming in and going out at the same time. DRAM reads or writes one instruction at a time. So lots of VRAM helps. But to really get speed you need to deal with the PC bus.

One of the biggest bottlenecks for graphics on PCs has been the antiquated "ISA" bus designed for the original IBM PC. The ISA bus moves data from graphics cards to the CPU and back. ISA is narrow (16 bits) and slow (8MHz). Stuffing a full-color, bit-mapped Windows 3.1 screen through an ISA bus is akin to a snake eating an elephant. Although later bus designs—IBM's

Some Leading Vendors of 24-Bit Boards

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2675 Patton Road
St. Paul, MN 55113
CIRCLE 210 ON INFORMATION CARD

ATI Technologies Inc.
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Scarborough, Ontario, Canada
M1W 3S2
CIRCLE 211 ON INFORMATION CARD

Boca Research
6413 Congress Ave.
Boca Raton, FL 33487-2839
CIRCLE 212 ON INFORMATION CARD

Cardinal Technologies
1827 Freedom Road
Lancaster, PA 17601
CIRCLE 213 ON INFORMATION CARD

Diamond Computer Systems
532 Mercury Drive
Sunnyvale, CA 94086
CIRCLE 214 ON INFORMATION CARD

Genoa Systems Corp.
75 E. Trimble Road
San Jose, CA 95131
CIRCLE 215 ON INFORMATION CARD

Hercules Computer Technology Inc.
3839 Spinnaker Court
Fremont, CA 94538
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Lexington, MA 02173
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Omnicomp Graphics Corp.
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Houston, TX 77043
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Orchid Technology
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Fremont, CA 94538
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Sigma Designs
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SPEA Software AG
Moosstrabe 18b
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Germany
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SuperMac Technology
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Indianapolis, IN 46256-3919
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Cambridge, MA 02142
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Video7
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Western Digital Imaging Systems
8105 Irvine Center Drive
Irvine, CA 92718
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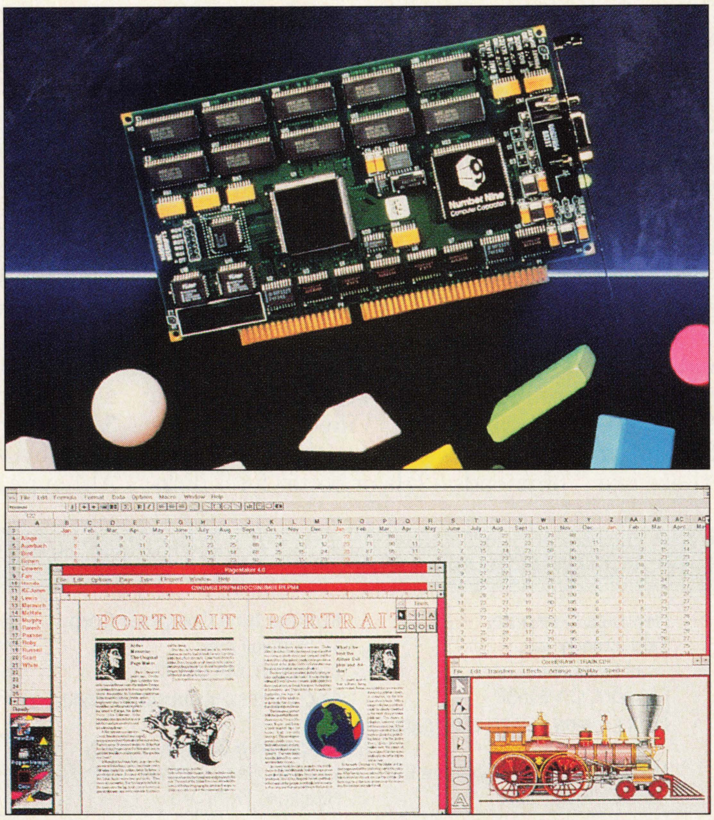
MicroChannel bus and the EISA bus—widened the data path to 32 bits, neither has become an overwhelming success.

Companies have circumvented the bus somewhat by offloading graphics processing to on-board chips such as the programmable TI 34020, which appears on many of the cards in Peddie's highest-end category, and to hardwired chips such as those from S3.

With the end of the 34020 series drawing near, many companies are designing their own chips. Matrox, for example, has a new 64-bit "MGA" graphics engine powering its latest cards. And SuperMac's new $999 card includes 96-bit-wide, 24-bit ASICs (application specific integrated circuits) to produce 24-bit color at 1152-by-910 resolution. "Right now, the fastest ISA cards you can get in category three are Weitek P9000 and IIT 014-based boards," says Peddie. "In the high end, the fastest ISA cards are the Weitek P9000 and TI 34020 cards. And on paper, the new Matrox chip shows great promise."

In addition, using a benchmark called "Photostones," developed by SuperMac, which measures millions of 24-bit pixels per second, Peddie found that company's color card outperforms its nearest competitors in this area.

The second way companies are speeding graphics is by avoiding the ISA bus and using the so-called "local bus." This bus is "local" to the CPU—that is, it sits on the motherboard and operates at CPU speeds. First offered as a proprietary bus by vendors such as Dell, the local bus standard, developed by VESA in 1992, has begun to be implemented on PCs from such companies as Gateway. Although surrounded by much hype, local-bus machines do offer faster graphics and are recommended for image-editing applications.



Based on the S3 86C928 graphics engine, Number Nine Computer's VESA local bus version of the #9GXE Windows Accelerator (top) offers many high-end hardware and software productivity aids to the CAD market. To boost Windows productivity, the HawkEye feature set of Number Nine's #9GXE Graphics Engine (bottom) provides users with the ability to keep several full-size applications open simultaneously.

After testing 50 boards, Peddie Associates found the performance difference between similarly equipped ISA and VL bus cards ranged from zero to 45 percent. "Even though you may hear ISA maxes out at 6MHz and the local bus is 132MHz, which is true, the overhead associated with Windows eats up so many CPU cycles, a local bus is not a panacea," says Peddie. "It's not as simple as providing a larger-diameter hose between the CPU and the screen."

But it doesn't really cost any more, either. And local bus machines usually include an ISA bus so it seems to be a "win/win" situation, unless, that is, the marketplace gets clouded with lawsuits and competing standards. Dell claims to have a patent that predates the VESA standard. And an alternate to the VL bus called PCI is being promoted by Intel.

Meanwhile, most card companies are making VL versions of display cards—at least at the low end. And they're looking for other ways to distinguish themselves in this incredibly competitive market. NDI offers a limited lifetime warranty; Matrox offers CAD, Windows, and video on a card with its fast new chips; ATI Technologies, one of the all-time market leaders, uses proprietary chips to get to what vice president of marketing Henry Quan calls "no-compromise graphics," which is 1024-by-768 resolution, 16-bit or better color, and performance fast enough that you can hit a key and an image appears. In addition, ATI is going after the emerging multimedia market. Artist Graphics, however, is "sticking to its knitting" with cards that appeal to a CAD market with acceleration for 3D as well as Windows and 24-bit color, and Hercules has a 34020-based card called Chrome it has optimized specifically for 24-bit color that handles 3M of VRAM plus up to 40M of DRAM.

But, manufacturers' good intentions aside, do consumers care? "Just because you have a feature doesn't mean people want, need, or will pay for it," says NDI's Flora. "Everyone's doing features," says Wickes. "The consumer's only issues are price and speed." That opens the doors to the "no-name" manufacturers. Peddie agrees. "It's a culture problem in America," he says. "No one ever pays retail, and it doesn't matter as long as it's cheaper. So manufacturers think they can whittle off one dime and get success. But the companies cutting prices won't be around, so buyer beware." That is, unless you're buying a commodity-priced $150 card, and you don't care. To quote IDC's Blom: "Boy, have things changed." *CGW*

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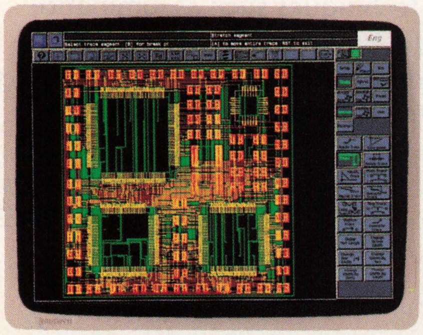

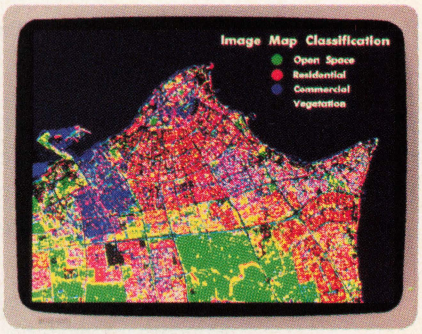

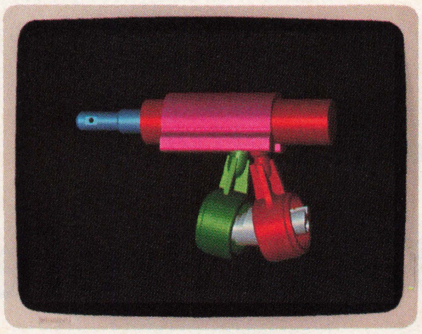

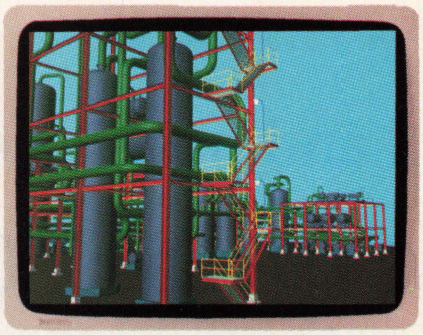

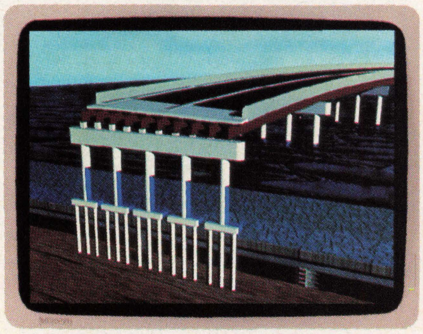

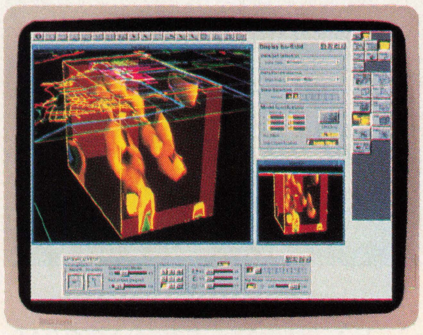

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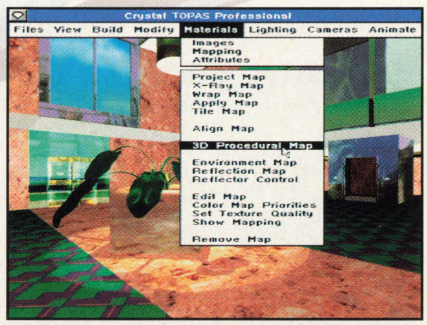

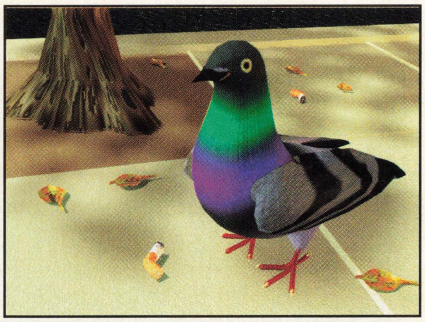

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CIRCLE 18 ON INFORMATION CARD

Sketch Modeling

Packages that soften CAD's hard-edged precision help designers conceptualize their plans

By Bobby-Jo Novitski

A site photograph of Savannah is the backdrop for a building facade modeled in form•Z and rendered with the ElectricImage Animation System (Electric Image; Pasadena, CA). Mark Kyle, along with Hansen Architects of Savannah, Georgia, created the image.

Dazzling architectural renderings are becoming almost commonplace lately, and it's tempting to imagine that photo-realism represents the apex of computer-aided design. But beautifully detailed displays offer little help to architects struggling through the early stages of design. Before a building has taken form, many designers prefer to work with deliberately simple models. To support schematic design processes, several low-end modelers allow designers to explore techniques for drawing in 3D, softening the hard-edged precision of CAD and making its use feel more like freehand sketching.

Early in design, architects mentally juggle hundreds of different, even conflicting, considerations. They must accommodate functional, social, economic, ecological, and structural aspects of the design while sculpting the building's form and appearance. During this difficult formative stage, architects have traditionally made quick, rough sketches, in contrast to the precise, studied drawings they produce later as construction documents. These sketches, says Jeff Logan, of the architectural firm Kaplan McLaughlin Diaz in San Francisco, need to be "clearly ambiguous." The uneven, fuzzy lines permit the mind to explore and even to discover ideas that were unintended in the sketch.

Unfortunately, the clean, precise lines on computer screens may repress that spirit of exploration. "We need the electronic equivalent of Legos," says Logan, "which you can play with and assemble in 3D until a light goes on in your head and you know that you've created a good idea." This is referred to as "sketch modeling."

Making it possible for architects to work in 3D has been very difficult for programmers because every point on a two-dimensional screen represents an infinite number of points in space, so the 3D position of a cursor is ambiguous. Successful approaches are based on innovative user interfaces that rely on positional cues and on ways people tend to view solids: as points, vertices, edges, and surfaces. Making these interfaces easy to use has been both difficult and of primary importance in software that tries to encourage exploration. Contrary to marketing claims, most modeling packages force designers to depart from their customary, visual thinking processes. "But if you have to think about what you're doing on the computer," Logan contends, "you're not really thinking about design."

With this in mind, several modeling packages permit the designer to manipulate form "directly" while viewing it in 3D.

The capabilities of the available programs vary. For example, unlike most of the low-end programs, form•Z from autodessys (Columbus, OH) is a true solid modeler that understands the geometry of 3D objects. This makes it possible

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Bobby-Jo Novitski is an architectural technology writer living in Eugene, Oregon, and a contributing editor to *Architecture Magazine.*

for users of the Mac-based program to perform the Boolean operations of union, intersection, and difference, enabling them to add and subtract complex forms while letting the computer worry about the precise shapes of the resulting planes and forms.

Another program, Alias Upfront from Alias Research (Toronto), which is available for both Mac and PC/Windows platfoms, differs from other packages in that it allows the use of a scanned-in perspective image, such as a site photograph, as a backdrop for the computer model. The 3D view can be adjusted to match the perspective of the backdrop, producing realistic settings for models without the need for extensive image processing.

A distinctive characteristic of DesignWorkshop from Artifice (Eugene, OR) emphasizes ease of use through its MacDraw-like interface. The user creates, moves, copies, and modifies objects with familiar click-and-drag methods that have been transferred into the 3D environment.

Despite their differences, however, products offering sketch-modeling capabilities share the ability to provide users with a sense of control over the medium and a level of visual feedback that is essential to schematic architectural design, yet is missing from most other modelers.

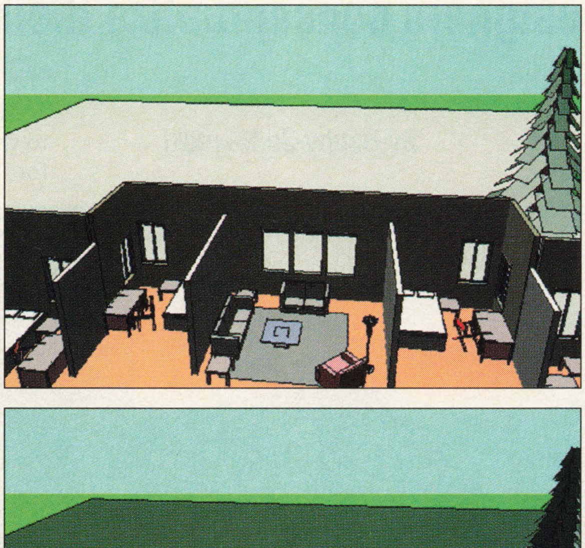
Mark Kyle, of LightPoint Digital Media in Atlanta is a strong believer in the power of front-end modelers used in conjunction with other media. A systems integration consultant, Kyle helps architects combine Macintosh software with existing PC and Unix workstation networks. "Form•Z lets you work in 3D," Kyle says, "in contrast to other packages that only give you a series of 2D views. In 3D space, you can manipulate things easily by clicking and dragging any point, line, segment, or series of segments."

Kyle says form•Z allows the user to think either like a sculptor carving forms or like an architect assembling parts. "I can simulate sculpting with the Boolean functions. For example, I can define any shape and cut it or cut another shape with the first shape. The mesh manipulation tool performs like a clay modeler. Or I can construct a building as I would in the real world by assembling elements like slabs, studs, and frames. Form•Z gives you flexibility to think about things three dimensionally, but within a controlled, precise environment."

Kyle describes a bar in Miami, which he helped design, made of organic shapes that would have been impossible to create in other modelers. The bar was curved in plan and had a sloping underside. The supporting concrete wall below was also curved. "All those intersecting forms would have been a nightmare to design or draw by hand," Kyle admits. In form•Z, he drew the 2D shapes, extruded them, and intersected the masses, without needing to join them precisely or trim them. He says, "Form•Z lets me be messy and loose while designing and still have a nice-looking final product. I can slap things together very quickly and get feedback that's accurate, even though I wasn't accurate in the process."

Patrick Mays is the CAD administrator for the architectural firm of Backen Arrigoni & Ross in San Francisco. He uses Upfront for quick modeling of rectilinear forms; Sketch, also from Alias, is similar but can also handle curvilinear forms through spline-based modeling. In both programs, Mays appreciates the ability to do quick lighting studies that show where shadows will be cast on and by buildings. This is important to understand early in design because the building's form can make or break opportunities for solar access and control.

Later in design, when details are being worked out, it's difficult or impossible to change previous decisions about overall form. "We know how to read sun path diagrams and do the calculations by hand to project shadows," says Mays. "But computer models make it easier, so we think more carefully about solar control, and we tend to do it a lot more often."



New campus buildings for the University of California at Davis were modeled in Upfront and Macromedia's ModelShop by architects Backen Arrigoni & Ross. After the sun (top) and shadows (middle) were projected, the designers softened the image (bottom) with freehand effects from Fractal Design's Painter.

When Mays uses the Alias programs for conceptual design, he likes to represent his models with the nonprecise lines that architects traditionally use for preliminary sketches. Although the modelers do not themselves produce "fuzzy lines," this effect can be achieved by the selective use of a series of tools. For example, he might build the model in Upfront or Sketch, then generate a perspective to export to Adobe Photoshop (Mountain View, CA). There, he combines the rough shaded model with photographs of the existing site that have similar lighting and uses filters to give the image a pastel or watercolor appearance. In conjunction with a pressure-sensitive Wacom tablet (Wacom Technology; Vancouver, WA) and Painter software (Fractal Design; Aptos, CA), he produces watercolor-like effects for finishing touches. "Each package has an area of strength," Mays explains. "The ability to mix media allows you to choose a slightly different tool for each part of the work."

According to Logan, another benefit of sketch modelers is to alleviate a common schism in architecture firms between those who design and those who use computers. Typically, designers do their creative work on paper, then give the results to someone else to input into CAD. Logan argues, "An architect who has to communicate with the computer through an intermediary is missing the boat. I think the person making the design decisions should be the one to manipulate the data. To get designers to use computers requires a simple interface that could make them functional in an hour."

Ease of use, thinking in 3D, working with irregular masses, fast access to solar projections, and the ability to generate "fuzzy" interpretations all contribute to the concept of sketch modeling. In the future, state-of-the-art technology may continue to be defined in terms of increasingly sophisticated, high-resolution, texture-mapped, and ray-traced images. But support for the seemingly simple schematic design phase is also important. With several CAD vendors now offering these design tools, sketch modeling has come of age. *CGW*

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CIRCLE 20 ON INFORMATION CARD

A Concept for a Caring Car

A desire to preserve both the environment and customer comfort drives Volvo's latest creation

By Diana Phillips Mahoney

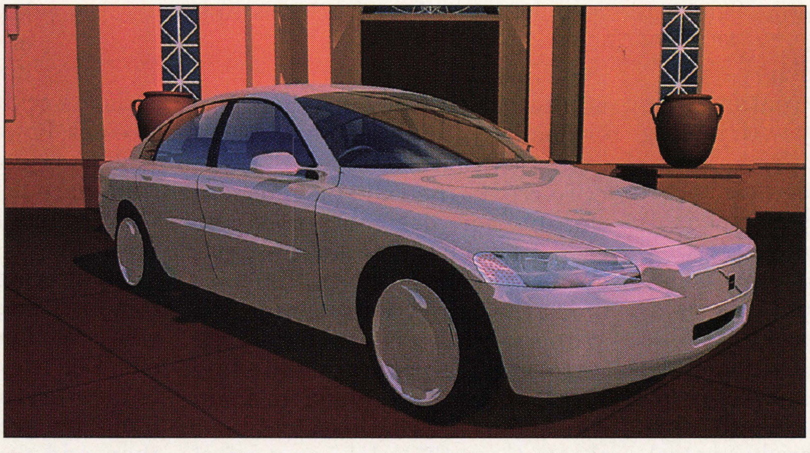
We'll recycle newspapers; we'll return soda cans for deposit; and we'll reuse grocery bags. But even the most environmentally aware among us will not surrender our cars in the name of ecological preservation. We know that they consume too much fuel. We realize, too, that they emit pollutants. But let's face it, we *need* our cars. We have to get to work and to school and to the ball game and to everywhere else that we have to go. We have no choice (well, we have no *convenient* choice).

A new "concept car" by the Volvo Corporation of Sweden, however, may help ease any internal conflict that such a situation might present.

Called the Environmental Concept Car (ECC), the innovative vehicle is an extremely low-emitting (sometimes no-emitting), aerodynamic, family-size car designed "from the inside out" using Alias Studio modeling software.

Developed by engineers at the Volvo Monitoring and Concept Center (VMCC) in Camarillo, California, the ECC— which premiered at last year's Paris Auto Show— sports a lightweight aluminum body and relies on a custom, hybrid power-train engine that runs on a combination of batteries and a gas turbine generator.

According to VMCC interaction designer Brad Lörhding, the ECC represents Volvo's attempt to satisfy increasingly restrictive environmental legislation without sacrificing the level of comfort to which consumers have grown accustomed.



The computer model of Volvo's Environmental Concept Car depicts the aerodynamic body of the pro-environment family car of the future.

"In California," says Lörhding, "we're already seeing laws come into effect that are saying there are going to have to be very low-emitting vehicles and zero-emitting vehicles basically by the end of the century."

But, he adds, "In talking to consumers, we learned that although they wanted lower-emitting vehicles, they weren't really willing to give up anything they have today. So that's basically where the car came from. We tried to do a realistic Volvo family car that's very fuel-efficient and very low-emitting."

The ECC presented designers with a creative challenge: Its appearance had to reflect its environmental advantages while retaining its "Volvo-ness." "It didn't need to look like previous Volvos per se," says designer Doug Frasher, who was responsible for the car's exterior, "but it had to fit into the Volvo lineage." (Actually, the ECC is based on the Volvo 850 platform.)

To create their computer model of the ECC, designers followed the CAD process that they had developed for previous projects, which includes, initially,- deciding on the criteria for the car and creating preliminary sketches.

"Typically, we'll explore a variety of themes and concepts in sketch," says Frasher. "As soon as our management is excited enough about a sketch that they think it's time to look at it in 3D, we scan the sketch into the computer."

For example, Frasher continues, "I'll scan a side view of the car and use that as a backdrop to get my basic side view elevation curves going. As soon as I get all of the

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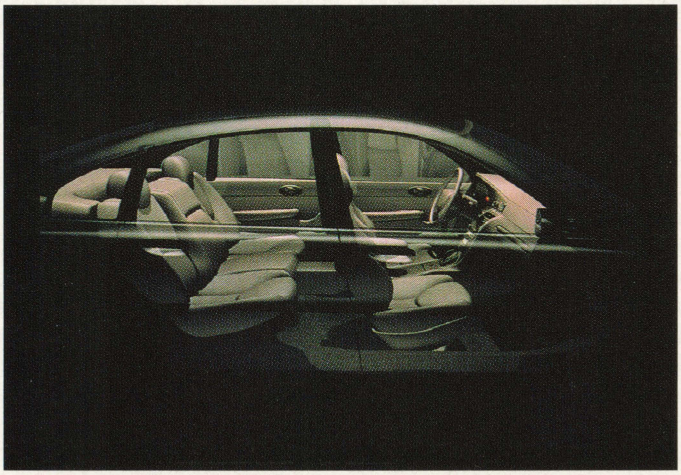
Diana Phillips Mahoney is an associate editor of *Computer Graphics World.*

curves and the character lines down in the side view, then I will grab each one of those, pull it out into its third dimension, and make it represent the basic form of the car."

To generate this basic form and evaluate their model, the designers utilize such capabilities as quick renders, quick shades, highlights, and ray tracing. Also, says Lörhding, "They may do a quick animation of a turntable to see the reflections move across the surface." When they are comfortable with the model, the designers release it for milling—with the milling paths done in IBM's Catia—to create a quarter-scale, polyurethane foam prototype.

According to Lörhding, because the designers have become very comfortable with Alias and because it has continually improved as a tool, "We've gotten to the point where we do very little surface work after the milling. We just sort of hit it with a little bit of sandpaper and paint and it's ready to go." The time savings such reliability affords, he continues, "is why we can get away with having only 10 people here."



The interior architecture and nearly all of the interior details of Volvo's Environmental Concept Car were modeled with Alias, providing designers with a sense for such factors as reaching, touch, and clearance.

With the ECC, the various sections of the car—fenders, roof, panel, hood, trunk lid, and so forth—were milled in wooden forms, on top of which the aluminum was molded. "My Alias database had to be used basically to make the tooling for the car. To my knowledge, nobody else has done that," says Frasher, noting that producing tooling-quality surfaces typically requires very specialized software. "I had to refine the surfacing on the car down to within one-half millimeter." As it turned out, Frasher's refinements via Alias were well within the necessary tolerance.

The innovative drive train benefitted from Alias designing as well. "We had done basic modeling on the computer that showed component layout, battery placement, heat engine placement, and controller placement," says Frasher. "So there was a skeletal building-block model on the computer that was very important in communicating throughout the company what the intentions were for this kind of car."

With respect to the car's interior, the computer imagery served not only as a communication medium and presentation tool to "sell" the design, but also as the database for a full-scale seating buck to use for evaluation of such factors as reaching, touch, and clearance.

To create the full-size model of the interior, designers used the cross-section tool to obtain cross sections every 100 millimeters along the car from the center out. With the cross-sectional data, they were able to generate full-scale plots, which they glued to foam core and used as outlines to cut out the sections. "This let us get a feel for the mass and the kind of space that would be available," says Lörhding. "And that's where we put the [prototypes] of the instrumentation, so you could actually have the realistic seating position and the realistic reach of the car's controls."

Developing the interior of the ECC was particularly exciting for a couple of reasons, says Gary FitzGerald, who was responsible for this aspect of the car's design. "For one thing, it was the first time we got to go directly into a model from the database. Another exciting part was that, on the interior, there were many surfaces that we never reworked at all: the entire upper dash, the bulk of the doors, and those areas of the consoles that didn't require change because of packaging. They basically just got cleaned up and went right to mold. The time savings was really incredible."

FitzGerald says he learned the "real art" of using computer modeling during the ECC project: "You have to balance the logistical problem of the sheer quantity of objects in an interior with the demand to model at a high level. If you try to model every knob and button and control in there to a very high level, you will inevitably run out of computer power and time on your calendar."

In fact, although FitzGerald used CAD to model nearly all of the interior details, such as door handles and radio controls, "I just didn't have time to model some of the final things, so I had some of the other artisans craft them by hand." He stresses, however, "It wasn't that it couldn't be done, it's just that I was running out of time and I didn't want to live in Sweden the whole year!"

In offering hints to potential computer modelers, FitzGerald advises: "Be honest about the tradeoffs. Don't try to make the computer do everything all the time. Use it for its greatest strengths and then add people and other tools where their greatest strengths are." Otherwise, he continues, "You may find yourself modeling, say, where the bottom of the dashboard meets the bottom of the door, and it's a real tortured shape. All of a sudden you've put 20 or 30 hours in that corner when in reality you can't even see it."

As for the ECC, Lörhding reports that it has received very positive reviews at various auto shows, including those in Paris, Birmingham, Los Angeles, and Chicago. The company recently took the car

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6-8 Printing Expo, Type-X, Art-X held in Philadelphia. Sponsored by Graphic Communications Three. Contact: Graphic Communications Three, 7500 Old Oak Blvd., Cleveland, OH 44130; 216/826-2878.

11-13 Rapid Prototyping & Manufacturing '93 held in Dearborn, MI. Sponsored by the Society of Manufacturing Engineers. Contact: Ms. Lori Hastie, The Society of Manufacturing Engineers, Conferencing Division, One SME Drive, POB 930, Dearborn, MI 48121; 313/271-1500 ext. 599.

18-20 GIS '93 held in Birmingham, England. Sponsored by Nina Gardiner & Associates Ltd. Contact: Ms. Jane Deal, Nina Gardiner & Associates Ltd., Blenheim House, 630 Chiswick High Road, London W4 5BG England; Tel: 44-81-742-2828; Fax: 44-81-742-3259.

19-21 ACM Symposium on Solid Modeling Foundation and CAD/CAM Applications held in Montreal, Canada. Sponsored by ACM, the Association for Computing Machinery, Special Interest Group GRAPH. Contact: Mr. Joshua Turner, Rensselaer Polytechnic Institute, CII-7015, Troy, NY 12180; 518/276-8713.

19-21 Virtual Reality '93 held in San Jose, CA. Sponsored by Meckler Corp. Contact: Meckler Corp., 11 Ferry Lane West, Westport, CT 06880; 800/635-5537.

24-27 Comdex/Spring '93 held in Atlanta. Sponsored by The Interface Group. Contact: The Interface Group, 300 First Ave., Needham, MA 02194-2722; 617/449-6600 ext. 4289.

24-27 Windows World '93 held in Atlanta. Sponsored by The Interface Group. Contact: The Interface Group, 300 First Ave., Needham, MA 02194-2722; 617/449-6600 ext. 4289.

25-27 NextWorld held in San Francisco. Sponsored by Digital Consulting Inc. Contact: Digital Consulting Inc., 204 Andover St., Andover, MA 01810; 508/470-3870.

25-27 Silicon Graphics Expo held in San Jose, CA. Contact: Silicon Graphics Expo, 12343 Hymeadow Drive, Bldg. 3, Austin, TX 78750; 800/727-EXPO.

25-28 Computer-Aided Technologies in Manufacturing held in Stuttgart, Germany. Sponsored by World Computer Graphics Association. Contact: World Computer Graphics Association, 2033 M St., NW, Suite 399, Washington, DC 20036-8446; 202/775-9556.

27-29 Multimedia '93 held in Toronto, Canada. Sponsored by Multimedia Trade Shows Inc. Contact: Ms. Susan Blair, Multimedia Trade Shows Inc., 7-70 Villarboit Crescent, Concord, Ontario L4K 4C7; 416/660-2491.

June

5-7 ShowBiz Expo held in Los Angeles. Sponsored by Live Time Inc. Contact: Live Time Inc., 2122 Hillhurst Ave., Los Angeles, CA 90027; 213/688-1811.

8-10 A/E/C Systems '93 held in Anaheim, CA. Contact: Ms. Sharon Price, A/E/C Systems '93, POB 310318, Newington, CT 06131-0318; 203/666-6097.

8-10 Autodesk Expo '93 held in Anaheim, CA. Sponsored by Autodesk. Contact: Ms. Lynne Saunders, Autodesk, 2320 Marinship Way, Sausalito, CA 94965; 415/332-2344.

8-10 Dexpo Spring held in Atlanta. Sponsored by Miller Freeman Inc. Contact: Miller Freeman Inc., 13760 Noel Road, Suite 500, Dallas, TX 75240; 800/87-DEXPO.

15-18 CAD/CAM/CAE/CIM Applications for Manufacturing and Productivity held in Prague, Czechoslovakia. Sponsored by World Computer Graphics Association. Contact: World Computer Graphics Association, 2033 M St., NW, Suite 399, Washington, DC 20036-8446; 202/775-9556.

29 The Electronic Book Seminar held in Boston. Sponsored by *Electronic Publishing*. Contact: Ms. Barrie Evans, *Electronic Publishing*, One Technology Park Drive, POB 987, Westford, MA 01886; 508/392-2187.

29-July 1 PC Expo held in New York. Sponsored by Bruno Blenheim Inc. Contact: Bruno Blenheim Inc., Fort Lee Executive Park, One Executive Drive, Fort Lee, NJ 07024; 201/346-1400.

July

7-August 7 Montage '93: International Festival of the Image held in Rochester, NY. Contact: Ms. Lisa Farrell, Montage '93, 31 Prince St., Rochester, NY 14607-1499; 716/442-8897.

19-23 ICS '93: International Conference on Supercomputing held in Tokyo, Japan. Sponsored by the Association for Computing Machinery. Contact: Ms. Julie Eitzer, Association for Computing Machinery, 1515 Broadway, New York, NY 10036-9998; 212/869-7440.

25-29 URISA '93 held in Atlanta. Sponsored by Urban & Regional Information Systems Association. Contact: URISA, 900 Second St., NE, Suite 304, Washington, DC 20002; 202/289-1685.

August

1-6 SIGGRAPH '93 held in Anaheim, CA. Sponsored by the Association for Computing Machinery's Special Interest Group on Computer Graphics. For Conference Information contact: SIGGRAPH '93 Conference Management, 401 North Michigan Ave., Chicago, IL 60611; 312/321-6830. For Exhibition Information contact: SIGGRAPH '93 Exhibition Management, 150 Burlington Ave., Clarendon Hills, IL 60514; 708/850-7779.

3-6 MacWorld Expo held in Boston. Sponsored by Mitch Hall Associates. Contact: Mitch Hall Associates, 260 Milton St., Dedham, MA 02026; 617/361-2001.

23-27 Comdex/Sucesu-SP held in Sao Paulo, Brazil. Sponsored by The Interface Group. Contact: Ms. Cheryl Delgreco, The Interface Group, 300 First Ave., Needham, MA 02194-2272; 617/449-6600.

31-September 2 Fed Micro CD-ROM and Multimedia Conference & Exposition held in Washington, DC. Sponsored by National Trade Productions Inc. Contact: Mr. Tom Lauterback, National Trade Productions Inc., 313 South Patrick St., Alexandria, VA 22314-3567; 703/683-8500.

September

14-16 Electronic Imaging held in Boston. Sponsored by Miller Freeman. Contact: Miller Freeman, 13760 Noel Road, Suite 500, Dallas, TX 75240; 800/223-7126.

Computer Catalog

The *1993 Computers In Science & Art Catalog* is available from Media Magic (Nicasio, CA) free of charge. This 88-page guide is packed with books on scientific visualization, virtual reality, fractals, chaos, artificial life, artificial intelligence, computer graphics, spirals and symmetry, patterns and forms, mathematics, the fourth dimension, and art. Also lists videos, software programs and their capabilities, magazines and periodicals, laser discs, CD-ROMs, and more.

CIRCLE 140 ON INFORMATION CARD

Integration Modeling

Proceedings are available from the First International Conference on *Enterprise Integration Modeling*. This book includes information on computer integrated manufacturing, open system architecture standards, and the results of five EI workshops on model integration, model/application namespace, heterogeneous execution environments, metrics and methodologies, and coordination process models. The MIT Press (Cambridge, MA), 563 pages, $45.

CIRCLE 141 ON INFORMATION CARD

C Guide

C for Windows Animation Programming contains the information needed to get the most out of designing and managing animation effects in Windows programming. The guide contains a disk which illustrates a variety of Windows-compatible screen animation control methods as well as motion and perspective techniques from runcycles and background pans to motion blur and deformation. Windcrest/McGraw-Hill (Blue Ridge Summit, PA), 672 pages, $39.95.

CIRCLE 142 ON INFORMATION CARD

Windows 3.1 Sound & Video

Discover Windows 3.1 Multimedia contains the information needed to get the most out of digital video and audio technology for PCs. The guide discusses how to capture and digitize video on the PC, produce animation, compress still images, and record, edit, and play back multimedia movies. Also contains a disk which lets users graphically create music fast, record and play back songs, send and receive MIDI data, edit, create original music with the PC, and more. Prentice Hall Computer Publishing (Carmel, IL), 800 pages, $39.95.

CIRCLE 143 ON INFORMATION CARD

Phigs 3D Guide

Phigs Reference Manual: 3D Programming in X is a complete reference covering PHIGS and PHIGS PLUS. The book contains all reference pages from the MIT X Consortium release and provides alphabetical reference pages for every function in the PHIGS programming library. O'Reilly & Associates Inc. (Sebastopol, CA), 1116 pages, $42.95.

CIRCLE 144 ON INFORMATION CARD

Photo CD Guide

Photo CD: Quality Photos at Your Fingertips contains the features and capabilities of Eastman Kodak's new Photo CD technology. The guide discusses uses for Photo CD technology, how Photo CD images are created, how to print, enhance and publish Photo CD images, and legal implications. Also includes sample images, technical illustrations, and diagrams. Micro Publishing Press (Torrance, CA), 232 pages, $27.95.

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back to Sweden for further testing, "so we can better understand this new, neat drive train and to work out all of the things that need to be worked out," says Lörhding. He predicts that, "If battery prices and the technology keep going in the direction that they're going, something like the ECC might be realistic by sometime soon after the year 2000. It's just a matter of getting the technology down to a point where it's much less expensive and more productive." *CGW*

An Enterprising Exhibit

By John Webster

"Beam me up, Scotty." Every hardcore *Star Trek* fan dreams of issuing forth this order from the Transporter Room of the starship Enterprise. For "Trekkies" visiting an ambitious display developed by the Oregon Museum of Science and Industry (OMSI) in Portland, it's a dream come true. Called *Star Trek: Federation Science*, the interactive exhibit based on the enormously popular television series taps computer graphics to simulate exploits in faraway galaxies by the crew of the Enterprise and uses *Star Trek* adventures to illustrate topics ranging from astronomy and physiology to propulsion and life-support systems.

Created with the cooperation of Paramount Pictures, the $1.4 million exhibit opened in January 1992 to coincide with the 25th anniversary of the television series and also to mark the 1992 International Space Year, designated by NASA and the United Nations. The exhibit even garnered input from the series' adulated creator, Gene Roddenberry, who, before his death in 1991, persuaded Paramount to cooperate with OMSI.

Featuring 40 modular exhibits covering 6000 square feet, *Star Trek: Federation Science* has as its main focus the Bridge of the Enterprise, which consists of a variety of consoles clustered at the base of a 120-inch viewscreen. Branching off from the Bridge are a simulated Transporter Room, Engineering and Sick Bay areas, and an Away Team area featuring astronomy and planetary exhibits. In almost all of the sections, visitors experiment with computer-generated scenarios to learn about fundamental concepts behind the adventures of the Enterprise.

To recreate the Bridge, OMSI combined a Mitsubishi rear-projection VS-1202 color monitor with four Macintosh IIci computers mounted inside the consoles. For a *Star Trek*-like environment, designers replaced the familiar Macintosh interface with Elographics TouchScreens built into Magnavox monitors.

Interactive custom software programs running on the Macs pose scenarios involving orbits, velocity, navigation, star and planet features, and remote sensing. When visitors successfully solve the computer-generated problem, they can choose from a selection of scenes to play on the main viewscreen, ranging from Enterprise fly-bys and space battles to exploding stars.

A Macintosh Classic computer acts as the video server to drive the Mitsubishi monitor. The Classic also controls a Pioneer LDV-8000 laserdisc player which has a Paramount-produced laserdisc containing the *Star Trek* scenes.

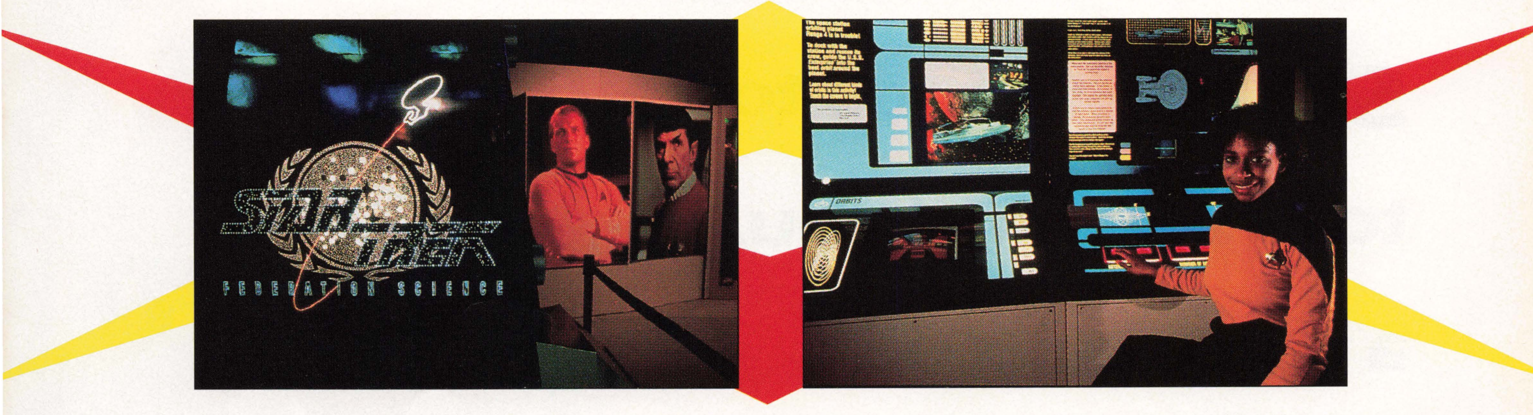
The four Mac-based Bridge stations run Aldus Supercard software to combine images of *Star Trek* characters and scenarios with questions, prompting visitors to make "mission-critical" decisions. All four use the Mac's built-in, 8-bit graphics hardware, and an AppleTalk network connects them with the Mac Classic .

The Paramount Pictures designer who created the Enterprise's instruments and controls supplied 40M of graphics and animation, some of which OMSI software engineers modified to produce the final programs. One such program, called Asteroid Alert, introduces visitors to force and vector concepts. Upon initiating the Asteroid Alert scenario, Lt. Wharf (a character from *Star Trek: The Next Generation*) appears on screen along with text that sets the scene.

In a typical Asteroid Alert scenario, the Mac first paints the planet and asteroid on screen, along with a set of controls on an arrow pad for moving the tractor beam. An asteroid is on a collision course with a planet; to avert mass destruction, the Enterprise must use its tractor beam to change the projectile's course. Visitors can also position the

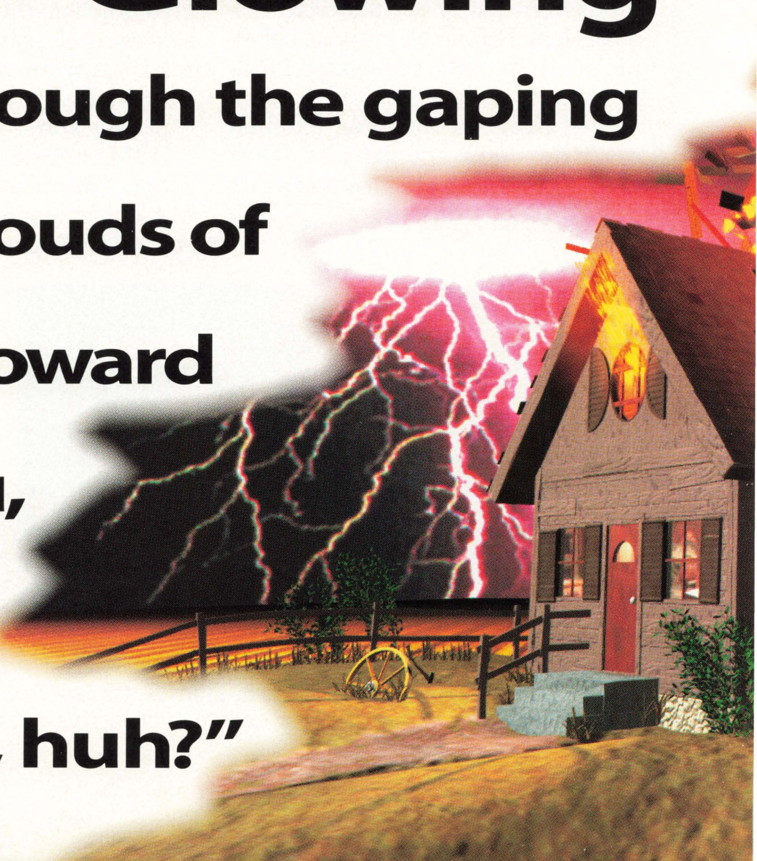
continued on page 58

John Webster is a freelance writer based in San Francisco.



Using the popular TV series as its premise, the *Star Trek: Federation Science* exhibit provides an entertaining platform for teaching a range of scientific concepts through various interactive displays.

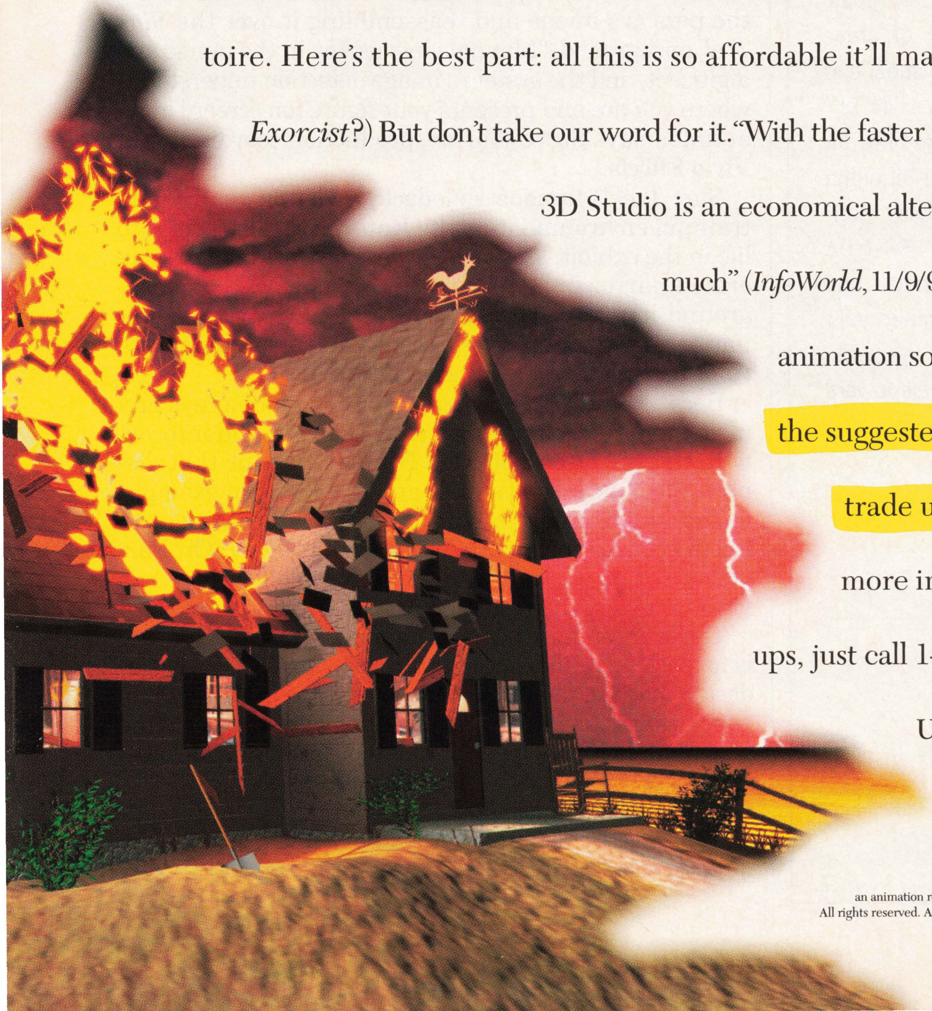
Raindrops as big as marbles pound the plains of Nebraska, washing away the tender wheat. Blades of **lightning** slice the night like a giant salami. Suddenly, the old Mackey farmhouse **explodes**, hurling rotted planks and rusted nails into the darkness. **Glowing** timbers peek through the gaping roof as swollen clouds of **smoke** roll toward town. Behind you, a voice calls out, "**Killer** effects, huh?"



Strange things happen when you get your hands on Autodesk **3D Studio**® software. Right out of the box, 3D Studio Release 2 has everything you need to create broadcast-quality animation on an ordinary PC. It's the hottest animation software on the street. (It's copped lots of awards, too, if you're into that.)

Only 3D Studio gives you the whole enchilada. A powerful 3D modeler for creating complex sculpted shapes. (Everything from effete espresso makers to your favorite reptiles.) A comprehensive materials editor for rendering with automatic reflection, texture, bump, and opacity mapping. (They'll call you *the Texturemeister.*) A keyframer that lets you swiftly create animation paths with automatic banking. (So you can attack the Death Star.) And built-in video-post capabilities that turn your PC into a video production suite. You can render finished animations to tape or disk in one pass. (With effects!) You even get a killer CD ROM packed with 500 megabytes of prebuilt objects and textures.

But there's more. The open architecture of 3D Studio lets you use independent developer applications with outrageous special effects—the kind you only see on the big screen. Now you can add morphs, explosions, ripples, waves, smoke, meltdowns, and other forms of destruction to your repertoire. Here's the best part: all this is so affordable it'll make your head spin. (Remember *The Exorcist*?) But don't take our word for it. "With the faster rendering time and external processes, 3D Studio is an economical alternative to systems costing 10 times as much" (*InfoWorld*, 11/9/92). If you're struggling with some other animation software, don't panic. You'll get $500 off the suggested retail price of 3D Studio when you trade up from other eligible software.* For more information on 3D Studio and trade-ups, just call 1-800-879-4233, ext. 238. Outside the U.S. and Canada, fax 415-491-8311.



Autodesk®

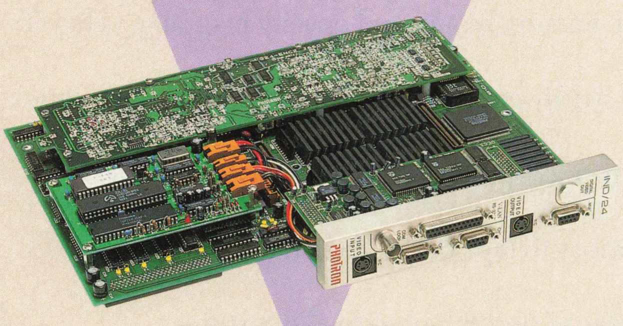
*Offer expires July 31, 1993. "The Burning Farmhouse" is an unretouched frame from an animation rendered using 3D Studio software plus IPAS effects on a 486 PC. ©1993 Autodesk, Inc. All rights reserved. Autodesk, the Autodesk logo and 3D Studio are registered trademarks of Autodesk, Inc.

CIRCLE 22 ON INFORMATION CARD

Photron introduces

Desktop Video Power for the IRIS Indigo™ Workstation

OSCON® IND/24™ Frame Buffer Board



Installed on the Entry Graphics Board using the LG2 bus, the Oscon IND/24 Frame Buffer Board provides full professional video production for the IRIS Indigo platform. For enhanced video production power, the Oscon IND/24 features two video inputs for wipes, dissolves, keying and an endless variety of creative effects; buffered frame output (2 to 4 frames) and frame-by-frame control via the internal V-LAN-T™ for animations, a realtime video canvas facility for paint applications, a separate channel for 8-bit alpha blending and 4-bit overlays, broadcast-quality genlocked output in full compliance with the EIA RS-170A standard, a variety of output signal formats, and much, much more. For that extra edge to make your video productions stand out from the rest of the pack, the Oscon IND/24 Frame Buffer Board empowers your creativity.
Driver software comes bundled.

IRIS Indigo is a trademark of Silicon Graphics, Inc.
OSCON is a registered trademark of Photron Limited.
IND/24 is a trademark of Photron Limited.
V-LAN-T is a trademark of Videomedia, Inc.

*Specifications subject to change without notice.

PHOTRON

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Enterprise anywhere on the screen before firing the beam. Lt. Wharf's recorded voice chimes in periodically with admonitions such as, "Your present actions produce more harm than good."

To aid the viewer during the mission, the Enterprise's Library Computer Access and Retrieval System (LCARS) delivers data about the asteroid such as its trajectory and the forces required to knock it off course. "You have to apply the force at exactly the right angle to the asteroid's trajectory by trial and error until you get it right," says OMSI software engineer Michael Ratliff.

In another area, one of the Enterprise's most familiar settings is recreated: the Transporter Room. Here, visitors can watch their mirror image on a 50-inch computer monitor as they "beam down" to an exotic location and interact with objects they see on the monitor.

The exhibit is based on a form of virtual reality developed by Vivid Effects (Toronto) called the Mandala Virtual World System. The equipment comprises a standard RGB video camera attached to an accelerated Amiga 2500 machine running the Mandala software.

Without relying on cumbersome helmets, gloves, and other gear, the system captures a person's image as they stand before a blue background. When a visitor steps under the lights of the exhibit, the software chromakeys the person's image over one of five *Star Trek* environments. The new background and audio are stored on a laserdisc, also controlled by Mandala.

On a second Amiga system, a Newtek Video Toaster handles the beaming illusion, which involves dissolving the person's image and reassembling it over the *Star Trek* background. "Mandala lets us key in the image and digitize it, and the system's image detection understands where you are and presents your figure [on screen] in real time," says Steve Warme, production coordinator at Vivid Effects.

Star Trek's famous Holodeck, a virtual reality and training environment on the Enterprise, also comes to life in the exhibit. Visitors can watch their Mandala-generated mirror image "beam" into the laserdisc's background imagery. The system randomly selects a scenario, ranging from jungle scenes and sports games to ruins on a planet called Farpoint Station.

Because the video camera records and displays any movement by visitors, they can reach out and interact with images on the 50-inch Hitachi monitor that displays all of the exhibit's video and graphics. For example, in the jungle environment, a visitor can reach out to touch a bird, which squawks and flies away. On Farpoint Station, the walls of the ruins crumble faster when visitors "touch" them on screen.

The overt premise behind *Star Trek: Federation Science* is to teach scientific concepts, according to Divonna Ogier, design manager at OMSI. She notes, "The [*Star Trek*] series packages science in an interesting way to draw in the general public, ranging from those people with only a basic level of knowledge to scientists themselves."

After a nine-month stay in Portland, *Star Trek: Federation Science* took to the road in October 1992 and is making scheduled stops at museums nationwide. *CGW*

Compressing Still Images

A variety of products battle for attention in this fiercely competitive market

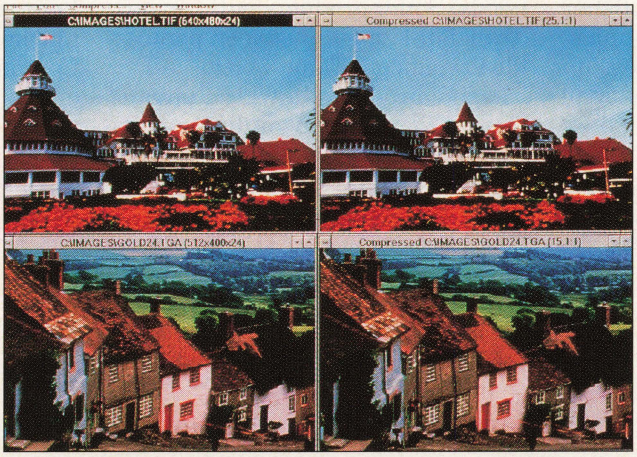
By Laura Lang

As digital pictures become an increasingly common commodity in our computer-saturated work environments, more and more people are sacrificing vast amounts of disk space to store and retrieve images. Real estate agencies building photographic databases of houses, artists and publishers building libraries of images, and companies and government agencies building photo ID systems—all face the constant struggle to squeeze 10 pounds of data into a 5-pound digital bag.

Enter still-image compression technology, a way of reducing full-color or gray-scale images at ratios as high as 30-to-1. Achieving image compression at these levels allows a 50M disk that normally holds fewer than 400 images to hold more than 5000 images. Likewise, it makes it possible to reduce a two-minute image transmission on a 9600 baud modem to less than 10 seconds.

Image compression products come in a variety of flavors. Some are software-only products, some are add-on boards, and some come as bundled packages that include compression software and accelerator cards. The trend in the market, however, favors the software-only approach as host machines to run compression algorithms become faster. Software products range in price from $75 to $90 for shrink-wrapped DOS/Windows utilities. Board products hover around $1000.

Although image compression products are often sold to end users for use in stand-alone systems, vendors say the majority of their sales these days are to system integrators seeking to integrate the technology within their own applications packages, such as desktop publishing programs.


C:\IMAGES\HOTEL.TIF (640x480x24)
Compressed C:\IMAGES\HOTEL.TIF (25:1:1)
C:\IMAGES\GOLD24.TGA (512x400x24)
Compressed C:\IMAGES\GOLD24.TGA (15:1:1)

Compressed images ease image storage, retrieval, and transmission problems. (Image courtesy of Telephoto Communications)

By far, most of the still-image compression products on the market today are built around the JPEG (Joint Photographic Experts Group) standard. JPEG is ISO's (International Standards Organization) standard for compression of continuous-tone color and gray-scale images.

Although vendors tend to implement slightly different variations of this standard, the typical JPEG compression ratios are 30-to-1 for color and about 10-to-1 or 15-to-1 for gray-scale images.

But there are also inherent drawbacks to JPEG. For example, JPEG compression products sacrifice some image detail for the sake of compactness. Although the quality loss in an image that has been compressed one time may not be noticeable by the average user, you can't edit and compress an image again without further degradation in quality.

To reduce degradation, a user must decide on an appropriate compression level—selected from descriptive choices like good, better, best, and perfect—to specify the quality of the image. For most applications, a compression ratio of 20-to-1 or even 30-to-1 provides adequate picture quality.

The JPEG user must balance image quality against file size, according to Anne Marie Gunning, a marketing communications specialist with Storm Technology (Mountain View, CA). "The downside is that the user can lose quality if he misuses a JPEG product by compress-

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Laura Lang, a freelance writer based in Herndon, Virginia, is a frequent contributor to *Computer Graphics World.*

ing an image too far," she says.

An alternative to JPEG-based products are those based on fractal technology, a newer, mathematically based compression method. Fractal-based products search an entire picture for similar regions and then build a fractal equation (much like a Postscript formula) for the entire picture.

The advantage of fractal technology, says Jan Ozer, vice president of marketing at Iterated Systems (Norcross, GA), the leading supplier of fractal-based compression products, is that it can compress an image at a ratio of 100-to-1, with no apparent loss in quality.

Image scalability, adds Ozer, is also a key benefit of the fractal compression method. Images compressed with fractal technology, says Ozer, can be easily re-sized during decompression by "fractal zooming."

"If you're going to be zooming the picture at all—which most users will do—you need fractal compression," advises Ozer.

The bottom line is that when buying an image compression product, you must first identify your needs in terms of image quality, compression and decompression speeds, and product compatibility. A publisher printing on newsprint, for example, might opt for a fast compression product even though it loses a small amount of data, since his readers would not likely be affected by some degradation in image quality. A publisher of a coffee-table book, on the other hand, would likely demand a higher-resolution image and may be unconcerned with compression/decompression speeds.

When speed *is* an issue—such as for multimedia applications—you'll want to pay special attention to the decompression speeds, noting if they are "software-only speeds" or if they include the use of an accelerator card.

It's also worth noting that fractal technology generally decompresses images faster than JPEG (though compression might be slower). As a result, fractal technology is favored for compress-once-decompress-many-times applications (display applications), while the real-time desktop publishing market currently favors the JPEG approach.

There are also many different formats for image files (PCX, TIFF, GIF, WPG, BMP, DIB, VIA, EPS, VFF, and SunRaster, to name a few), so it's important to know which formats are critical for your needs. Some products will convert (translate) images between popular file formats and some won't.

A few products have the advantage of working on multiple platforms. Images compressed with ALICE from Telephoto, for example, can be retrieved by any other ALICE product regardless of platform, operating system, or environment. ALICE runs under DOS, Windows, OS/2, SunOS (Solaris), AIX (RS-6000), and other Unix environments.

In the future, we can expect more vendors to pick up on this capability. "Any vendor that wants to stay competitive will have to move its compression technology across platforms in the next year or two," notes Ozer of Iterated Systems. "We're working toward that now."

An Uncertain Future

Ironically, despite the obvious need for compression technology in an increasingly picture-intensive world, the road ahead may well be a rocky one for image compression product vendors. In terms of revenue, the market is described as "shrinking," though more systems are expected to be sold for both PC and Macintosh computers. JPEG products, which represent the bulk of software sales, are estimated by vendors to have sold in the $10 million range in 1992. "That was probably a plateau," comments Leonard Roberts, vice president of marketing and sales for Telephoto Communications (San Diego). "Revenues this year will be way down,

COMPRESSION, *p.64*

Some Leading Suppliers of Image Compression Products

DOS/WINDOWS/UNIX

Aware Inc.
One Memorial Drive
Cambridge, MA 02142
CIRCLE 235 ON INFORMATION CARD

Cardinal Technologies Inc.
1827 Freedom Road
Lancaster, PA 17601
CIRCLE 236 ON INFORMATION CARD

HSC Software
1661 Lincoln Blvd., Suite 101
Santa Monica, CA 90404
CIRCLE 237 ON INFORMATION CARD

Iterated Systems Inc.
5550-A Peachtree Parkway
Norcross, GA 30092
CIRCLE 238 ON INFORMATION CARD

Lead Technologies
8701 Mallard Creek Road
Charlotte, NC 28262
CIRCLE 239 ON INFORMATION CARD

New Media Graphics
780 Boston Road
Billerica, MA 01821
CIRCLE 240 ON INFORMATION CARD

Optibase
4006 Beltline Road
Suite 200
Dallas, TX 75244
CIRCLE 241 ON INFORMATION CARD

Telephoto Communications Inc.
11722 Sorrento Valley Road
Suite D
San Diego, CA 92121-1084
CIRCLE 242 ON INFORMATION CARD

Video and Image Compression Corp.
2221 Rosecrans Ave., Suite 237
El Segundo, CA 90245
CIRCLE 243 ON INFORMATION CARD

Xing Technology Corp.
1540 W. Branch
Arroyo Grande, CA
93420-1818
CIRCLE 244 ON INFORMATION CARD

MACINTOSH

Adobe Systems Inc.
1585 Charleston Road
Mountain View, CA 94039
CIRCLE 245 ON INFORMATION CARD

Apple Computer
20523 Mariani Drive
Cupertino, CA 94025
CIRCLE 246 ON INFORMATION CARD

Envisio
2640 Patton Road
St. Paul, MN 55113
CIRCLE 247 ON INFORMATION CARD

Neotech
The Mall
120 Winchester Road
Chandlers Ford, Eastleigh
Hampshire SO5 2QD
England
CIRCLE 248 ON INFORMATION CARD

Radius Inc.
1710 Fortune Drive
San Jose, CA 95131
CIRCLE 249 ON INFORMATION CARD

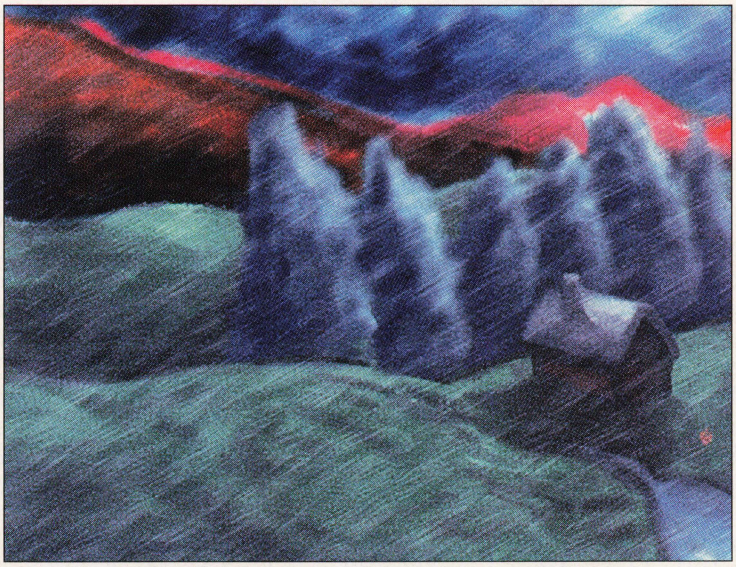
Storm Technology
1861 Landings Drive
Mountain View, CA 94043
CIRCLE 250 ON INFORMATION CARD

SuperMac Technology
485 Potrero Ave.
Sunnyvale, CA 94086
CIRCLE 251 ON INFORMATION CARD

Painting Up a Storm

Painter 2.0 forms a vital part of the digital artist's toolbox

▲ Fractal Design Corp. (Aptos, CA) is now shipping a faster and more responsive Painter package for both the Macintosh and Windows environments. Priced at $399 (a $79 upgrade), Painter 2.0 functions respectably with a mouse or a trackball, although its luxuriant power can only truly be appreciated when you use a pressure-sensitive tablet. With the exception of Time Arts' Oasis software for the Macintosh (which looked promising two years ago but since then has not improved its sluggish performance) and high-end PC programs such as Time Arts' Lumena (costing thousands of dollars), Painter is the first Mac or PC paint package that allows virtually all of its available painting and drawing tools to be responsive in opacity, density, and size (of mark) to the degree of pressure exerted by an artist using a pressure-sensitive tablet with a stylus.



© 1993 Sharon Steuer

A torrent of tools from Fractal Design Painter 2.0 played a role in the creation of "Spring Alp Storm": chalk, airbrush, water, lighting effects, dye-concentration, and a special ("Really Cool Paper Textures") weave pattern.

Painter's tools simulate a wonderful variety of real-life artistic tools. Pastels and charcoals can interact with one of the many specialty paper grains and grounds, oil paints can be smeared together, and ink pens can respond calligraphically to the subtlety of a stroke. Other tools include water smudging, airbrushes that can "dodge" to lighten and "burn" to darken, liquid media, crayons, colored pencils, realistic felt pens, and pressure-sensitive erasers. In addition, Watercolor and (somewhat gimmicky) Artists Tools (such as "Van Gogh") exist; these tools work a bit differently in that they allow you to create a path that is transformed into the appropriate mark once you complete the stroke. Artists hungry for these effects will have to tolerate the necessary lag time between drawing a stroke and seeing the resulting mark.

In addition to allowing the use of plug-in filters, Painter 2.0 also provides a number of magnificent effects, such as the surface texture and realistic lighting effects. Perhaps Painter 2.0's most innovative feature is the tool that lets you record any Painter function and save it as a "session." Small sessions (a single painting stroke or the application of a filter) can be played back to automate repetitive tasks, while longer sessions (including the re-creation of an entire work) can seemingly materialize an image from scratch. Fractal Design has included a number of sample sessions that convincingly demonstrate how to achieve certain effects with Painter. Sessions actually occupy very little space on your hard disk, because they are not saving individual pixels but are, instead, recording strokes, movements, color selections, and effects determination and application.

The frisket tool and image manipulation functions in Painter have improved the editing of isolated elements within your image, but these features still don't approach the sophistication of either Fractal Design's ColorStudio photo-manipulation program or Adobe Systems' Photoshop. Furthermore, while basic brightness and contrast manipulation is now possible in Painter, the experienced digital artist will find that color-manipulation tools (which can affect the overall saturation or color balance of an image or selection) are still noticeably absent in this version.

Personally, I don't like the program's big, glitzy tool palettes, which prove visually distracting and physically intrusive on a 13-inch monitor. A scaling option designed to customize the responsiveness of a tablet to your touch is wonderful but annoyingly needs to be reset each time you start the program. And despite extensive cloning features that provide for myriad special filter-like, artistic effects, Painter 2.0 hasn't implemented a feature common to other programs that lets you define one area as a "source" (such as an eye in a face) and then paint from that source point each time you start a stroke (so you can paint the eye over and over, anywhere on your image). Current cloning in Painter, by contrast, requires you to re-reference the original eye before painting each cloned eye stroke (or else the system simply continues to paint in the entire face). This missing clone feature is a key component of realistic photo-retouching.

Regardless of the complaints I have about how various features are implemented, I can without reservation or hesitation recommend Painter 2.0 as an indispensable tool for the digital artist. With many functions that feel familiar and realistic, and others that are examples of computer manipulation at its best, Painter 2.0 will help ease the transition to the computer realm for even the most skeptical of traditional artists.—***Sharon Steuer,*** *a consultant and freelance computer graphic artist based in Bethany, Connecticut*

CIRCLE 125 ON INFORMATION CARD

Video Like the Big Boys Do It

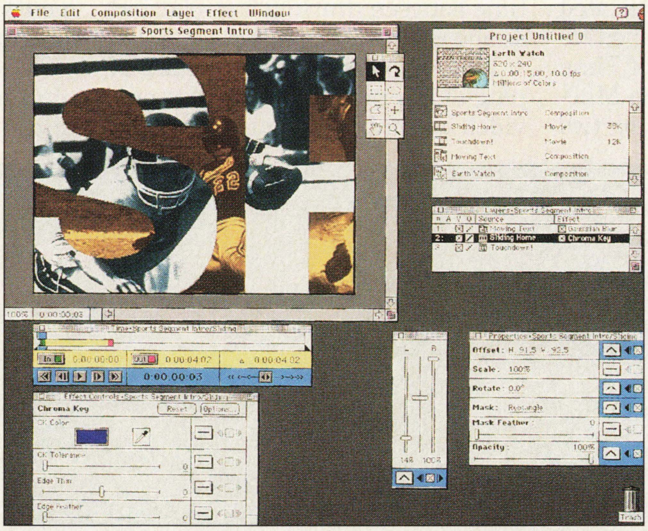
CoSA attempts to capture the sophistication of high-end video systems—with software on the Mac

▲ It's always exciting when trends intersect—in this case, digital video, QuickTime-based software, and multilayered video effects. CoSA After Effects from The Company of Science & Art (CoSA; Providence, RI) is an innovative software package designed with creative professionals in mind. For only $1295, it emulates the capabilities of the big-time video-effects compositors, such as the Quantel "brothers" Harry (R.I.P.), Henry, and Hal, which perform all of those layered text moves so popular in the current generation of TV commercials. But as opposed to Quantel, After Effects takes the revolutionary desktop-video (read "cost-effective") approach by using the Macintosh's QuickTime digital video standard.

CoSA After Effects is a true digital video layering, compositing, and special effects suite in a piece of software. Of course, your source material must also be in software (that is, digitized video on a hard disk rather than on tape). Having met this criterion, you can mix in virtually any other kind of digital Mac input, so that, for example, you can animate still images (PICT files) around and through QuickTime movies or combine videotaped footage with animations (PICS files) that were created in another program.

On top of this functionality, After Effects excels in its flexibility. Unlike Adobe Premiere and most other digital video software, After Effects lets you combine files and movies of virtually any size: from 160-by-120-pixel QuickTime movies to 4K-by-4K still images. Hooks exist for even more plug-in effects than those included (at press time, CoSA had just released "Additional Effects," a package of special effects being sent free to all registered owners).

In addition, After Effects meets the specifications of video professionals with an astounding array of high-quality options, including sub-pixel interpolation (averaging out even the finest details), field rendering for both NTSC and PAL output, full anti-aliasing, the controllable feathering of edges, motion paths with controls for multiple key frames (including variable interpolation methods, ranging from linear to spline-based auto-smoothing), and full alpha-channel support.



Layering to your heart's content is possible with CoSA's After Effects desktop video software, which allows for unlimited maneuvering of moving images and elements. The program's interface presents the user with floating window controls to address a rich array of capabilities.

In fact, the controls and capabilities of After Effects are so impressive that Robert May, president of San Francisco's multimedia company Ikonic Interactive, has designated it the "Photoshop of Digital Video." Ironically, in the desktop video world, its ability to composite moving images can only be compared to Adobe's own Premiere digital video program. The difference is that for all of Premiere's amazing special effects capabilities, it only addresses two channels of video and a "super" channel for titles or PICT files. CoSA After Effects offers unlimited channels that all continue to be interactively related. This means, for example, that you can create a layered composition (let's say, the word "sports" as text with live-action footage running within it) and then use that element within a second composition, and so on. No limit exists to the number of elements you can combine and chain together—without the need to output an interim composition. The only limit may be your storage, or your patience.

I am fond of contradicting Star

Trekkies by asserting in one of my "media proverbs" that "Time, *not* space, is the final frontier." CoSA After Effects represents a perfect example of this phenomenon. While its capabilities provide Mac animators with power that may be compared to quarter-million- or half-million-dollar digital special effects boxes, the price that must be paid is one of time. While those high-end systems are basically real-time systems (what you see is what you get when you walk away from the $500-per-hour session with a finished tape), After Effects enables decisions that must later be rendered (or in the language of digital video, "compiled"). While rendering these moving images does not prove quite as time-consuming as rendering most 3D animations, it can still become an overnight affair.

But, bottom line, CoSA After Effects is a very exciting, new program that can lay legitimate claim to having defined a new cost-performance category of microcomputer-based digital video effects and animation production. Among the video professionals that I polled at this past January's MacWorld show in San Francisco, it was everybody's favorite new program. Some people will use it for "living storyboards," or "pre-visualization" of projects that will later be realized on higher-end systems. Animators with frame-by-frame recording capabilities will take this program to the max for the output of final product. There's no doubt that with CoSA After Effects, the connection between a video producer's imagination and the Mac's output has become a much tighter one.—***Jon Leland**, a writer/director whose Sausalito, California-based company, Communication Bridges, provides consulting and training on how to span "The Grand Canyon Gap" between people and technology*

CIRCLE 126 ON INFORMATION CARD

A New Side to Explore

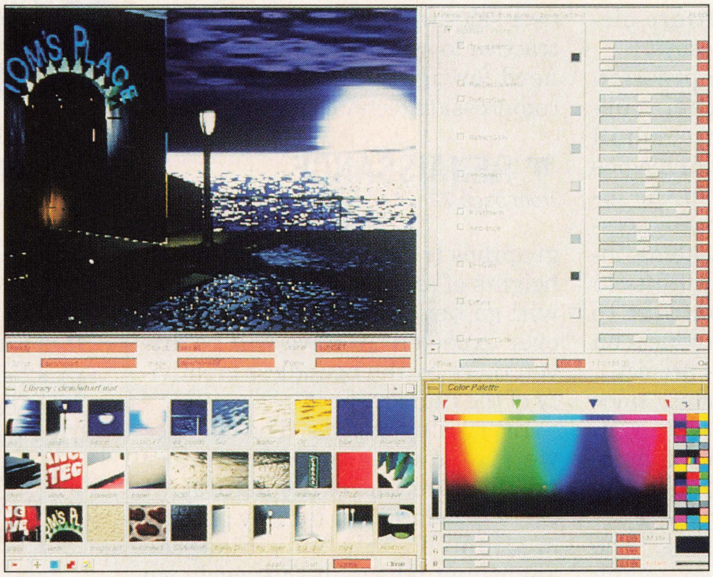
TDI's high-end package offers something unusual: interactive rendering

With the release of Explore 3.0.1, Thomson Digital Image (TDI; Paris and Los Angeles) moves out of one of the more stagnant periods in its nine-year history. After some initial problems with the original release, TDI has delivered a feature-rich package with excellent visualization capabilities.

Emerging from some corporate restructuring, TDI now sees its destiny as being firmly controlled by the European corporate giant Thomson S.A. This fact makes TDI unique within the ultra-competitive SGI (Silicon Graphics) 3D marketplace, as it is the only developer that enjoys major corporate backing. Development capital should never pose a problem for this group.

The 3.0.1 release offers various configurations geared at both designer and animator. As with most products in the SGI realm, pricing is set in accordance with the feature list. Explore, with its modeling, rendering, and animation capability, sits at the top of the TDI line; the $45,000 price is average for the high-end, workstation market.

In its interface, TDI uses a modular approach: breaking out tasks such as modeling, texture mapping, and animation into separate areas. The menus and working environment are completely customizable right down to the color and the display font. The pull-down menus appear whenever the right or left mouse buttons are pressed—economizing hand movements.



Render away: Once an initial rendering of a scene within Explore 3.0.1 is complete, users can then experiment on-the-fly with new rendering options. New materials, for example, can be picked directly from a library (lower left) and lighting can be automatically adjusted via sliders (upper right).

On the other hand, TDI uses the SGI dials box (a piece of hardware with a number of knobs that plugs into the serial port) to facilitate 3D movement and transformations within a single window. I found this setup to be somewhat cumbersome (in that it entails switching between the mouse and the box), but it is nothing to which a dedicated user would not adapt. However, while on the subject of interface, I feel that TDI needs to work on tying its higher-end functions more smoothly to the interactive interface sported by the rest of the package; as it is, users digging into the more sophisticated aspects of Explore must work with Unix command lines and text editors (rather than, let's say, sliders, or commands that can simply be picked from within the interface).

TDI has always possessed excellent modeling tools. The new release combines NURBS (Non-Uniform Rational B-Spline) and polygonal modelers within the same module. Either one of these capabilities could stand alone as an example of strong 3D manipulation. Included with the surface (NURBS) modeler are swept surfaces and trimming functions that promote the rapid construction of complex, organic shapes. The polygonal modeler includes all of the old favorites, such as Boolean operations, extrusion, and explosion, as well as the ability to produce some non-uniform deformations. Polygonal objects can be pulled and pushed in a "NURBS-like" (hence, fluid or plastic) fashion—providing a great way to create target geometry for morphing.

TDI has improved its texture mapping with a new Mapper module. Mapper lets users interactively position texture maps while receiving instant feedback, rather than having to go through some form of rendering. While support for the high-end SGI VGX graphics level exists, the Mapper performed very well on my Indigo Elan.

The animation module provides the usual high-end tools, including various key-framing techniques and animating along a spline path. The inverse kinematics facet present in previous versions has been removed but was scheduled at press time to reappear in a new release promised for next month.

The signature feature of Explore 3.0.1, and of TDI as a whole, is the new, interactive rendering module called IPR (Interactive Photo-realistic Rendering)—by far my favorite TDI element in that it releases you from having to use a renderer to visualize every scene. Once a model is rendered for the first time into the IPR format, you can choose from a large materials library to interactively apply and alter textures in a scene. All changes to the materials parameters are immediately updated on the screen with a visualization power that I have not yet seen on anything other than software supporting the more expensive SGI VGX graphics levels and above. You can alter lighting within IPR by simply moving sliders that control light color, intensity, and the penumbra on spotlights. Ray-tracing parameters can even be defined within IPR—allowing attributes such as reflection and refraction to be handled with ease.

Typically, with any given animation project, the artist/animator will spend well over half of the total project hours on modeling and rendering to prepare the scene for final animation and output. TDI does a fine job providing tools for this visualization phase. I found that the IPR module allowed me to achieve a more sophisticated look in a shorter time frame than would a 3D package relying on some traditional form of rendering for feedback.

TDI has tentative plans to expand its IPR technology into the industrial design and visualization markets. Sometime in late 1993, we may see IPR being offered in the $7000 price range as a rendering "back end" for other 3D software.

Other plans for TDI include a more affordable, entry-level system that will aim to tap into the fertile, low-end 3D markets. This release would represent a great move, as many potential PC and Mac users are still scared away from workstations because of extravagant software costs.—***Tony Simerman,*** *an artist/animator based in Centreville, Virginia, and a frequent beta tester of software packages*

CIRCLE 127 ON INFORMATION CARD

▼ COMPRESSION

from page 60

particularly as the hardware element of sales declines," he says.

Vendors of image compression software characterize their customer base as pragmatic, small companies looking for technologies that will work for them in the future. Many are customizing systems, such as photo ID systems, in-house or are hiring consultants to build them. Few will continue to buy image compression products on a piecemeal basis, vendors predict.

In reaction to this uncertain sales climate, compression software vendors—predominantly small companies themselves in the $1 million- to $3 million-per-year range—are rethinking their sales strategies. "The opportunity to make money selling JPEG image compression software is waning," admits Roberts.

For some companies, such as Kodak—which offered a JPEG product for Macintosh users—this cloudy future is reason enough to bow out of the image compression market completely. For those who've chosen to forge ahead, however, the strategy of choice seems to be to try to offset the impact of shrinking end-user sales with products that are attractive to system developers with a need for tightly integrated image compression technologies. *CGW*

▼ RENAISSANCE

from page 72

graphics industry. We will reach heights of artistic achievement that will go beyond anything anyone ever expected. And we will be driven there by the boundless creativity of the human spirit.

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Visual Communications

Network Working

DataBeam has announced FarSite, a package that enables two or more users to work collaboratively on images, text, and other digital files over a network. Designers can employ the software for jointly creating or editing a drawing while discussing the drawing over the phone. The program is reportedly the first of its kind to support Postscript files of any size and the first to automatically resolve differences in screen resolution and window size. Price: $995. A Sun version is shipping. A PC version is slated to ship by the end of 1993. DataBeam (Lexington, KY).

CIRCLE 160 ON INFORMATION CARD

Photo CD and Photoshop

Eastman Kodak has released the Photo CD Acquire Module, a new plug-in for Adobe Photoshop. The module lets the user choose a resolution, carry out cropping, and adjust brightness, saturation, and color balance before loading an image into Photoshop. The module also provides 11 conversion metrics for importing PhotoYCC color information into Photoshop files, including gray-scale and video RGB conversion. Macintosh System 7.0 or later is required. Price: $59.95. The product is available. Eastman Kodak Co. (Rochester, NY).

CIRCLE 161 ON INFORMATION CARD

Making Multimedia Work

Lenel Systems has introduced a Windows-based package for multimedia management. MultiMedia Works combines the functionality of a multimedia player, a multimedia-enabling server, and a presentation builder. The software supports multimedia information in more than 40 formats, including Video for Windows, Digital Video Interactive, QuickTime, and PhotoCD. The user can play any multimedia file with the click of a mouse, and then use simple drag-and-drop or cut-and-paste commands to embed the file into other Windows applications. Price: $99. Lenel Systems (Pittsford, NY).

CIRCLE 162 ON INFORMATION CARD

Animator Upgrade

Mathematica has announced an upgrade of its Tempra Turbo Animator. The company stresses that the software now supports Sony VISCA and other single-frame accuracy decks, allowing the user to create and store movie files that will play back at 30 frames per second. Other enhancements to the Tempra Turbo Animator include support for 16-bit animation and the company's new FLX file format. Price: $295 (as an add-on to Tempra Pro); $495 (as a standalone product that includes the Tempra Show multimedia presentation package). Mathematica (Lakeland, FL).

CIRCLE 163 ON INFORMATION CARD

Wizard of Images

ImageWare has introduced an advanced 24-bit digital image manipulation and processing program for Windows. ImageWizard provides a layered workspace with one background layer and 99 object layers. Object layers can be independently processed and/or grouped. The package comes with independent object brush tools that include trim and untrim, blur, tint, and more. Auto-strip, stamp, sharpen, and other image-manipulation functions can be performed on a pixel-by-pixel basis. ImageWare Software Inc. (San Diego).

CIRCLE 164 ON INFORMATION CARD

Renderize for Windows 2.0

Visual Software has released an upgrade of its photo-realistic 3D image-rendering utility for Windows. Renderize for Windows 2.0 introduces the time-saving function of batch rendering. A new four-up option lets front, side, top, and camera views be viewed simultaneously, easing positioning of lights, cameras, and objects. Two other new features, planar and hemispheric reflections, are aimed at replacing the lengthy process of ray-tracing for adding reflections to images. Price: $895. The product is shipping. Visual Software (Woodland Hills, CA).

CIRCLE 165 ON INFORMATION CARD

PC-Based StrataVision 3d

Strata has introduced a PC-based package for 3D modeling, sculpting, metamorphosis, animation, and rendering. StrataVision 3d PC enables the designer to twist and bend an entire object as though it were made of clay or warp a complete model along an arc. Three-dimensional shapes, color, transparency, and light attributes can all be morphed over time. The program comes with Phong, Gouraud, metal, glass, and table shaders; solids; and 3D reflectance and texture maps. Texture maps can also be imported in TGA-32 bit, TIFF, and PCS formats. Strata (St. George, UT).

CIRCLE 166 ON INFORMATION CARD

Hot Stuff

Discreet Logic has announced Fire, a high-speed paint and image-retouching system for film and video production. The new software for Silicon Graphics workstations comes with texture, air, and solid brushes as well as such paint effects as smear, chrominance, luminance, stamp, and clone. Also included are pre-set filters, anti-aliased graphic and freeform shapes, and keyframe animation capabilities. The user can customize the brushes by "rewiring" thickness, opacity, jitter, and other paint characteristics. Price: $30,000. Discreet Logic (Montreal, Canada).

CIRCLE 167 ON INFORMATION CARD

VR Software

Division Limited has introduced virtual reality (VR) software for Silicon Graphics workstations. The new product family includes the Amaze world simulation and authoring tool, along with an advanced runtime software environment. When used with a position-tracking device, the software enables through-the-window VR. On larger SGI hosts, a head-mounted display can be added for fully immersive VR. Target application areas include CAD, molecular modeling, architectural walkthroughs, and simulation and training. Division Limited (Redwood City, CA).

CIRCLE 168 ON INFORMATION CARD

ISDN Video Conferencing

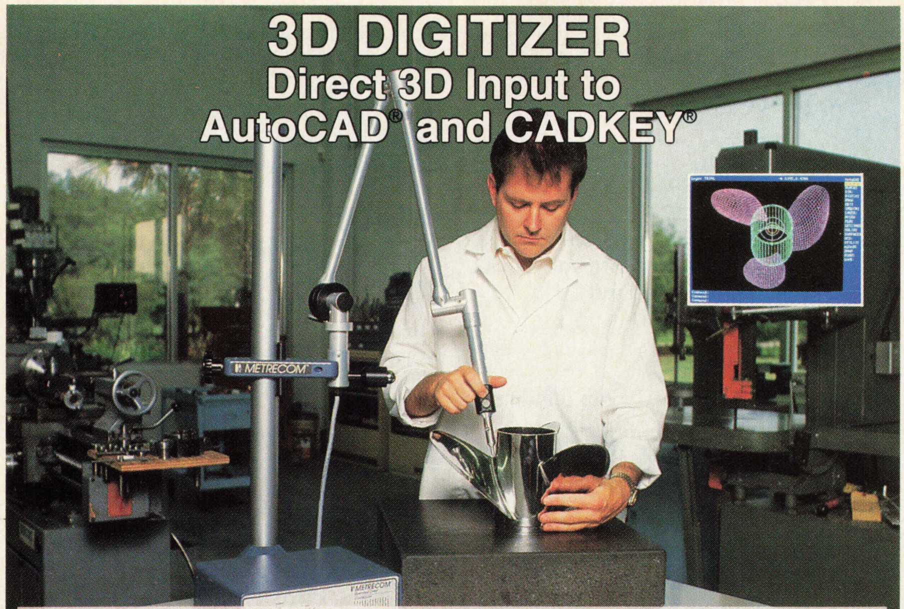
InSoft has introduced software that enables Sun workstation users to hold video conferencing sessions over 56K-per-second or ISDN lines instead of more costly T1 lines. An upgrade to the company's Communique multimedia groupware, the package uses new software compression ratios that work over lower volume lines with the four- or seven-bit gray-scale video offered by Sun's VideoPix board. Another new version supports the 24-bit full-motion color video of Parallel Graphics' XVideo board for Sun. Price: $1040 (for VideoPix); $1355 (for XVideo). InSoft Inc. (Mechanicsburg, PA).

CIRCLE 169 ON INFORMATION CARD

Output

Hi-Res Printers

XLI has released the Image Xpert Series of high-resolution, Postscript-compatible



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printers. Each consists of a laser printer engine plus a controller for an IBM-compatible PC. The Image Xpert 1000, 1000 LE, 5000, and 5000 LE print text and line art at up to 1200 dpi. Models 1000 and 5000 also print halftones at up to 2400 dpi. The 1000 and 1000 LE output on to 8.5-by-11-inch plain paper, and the 5000 and 5000 LE on to 8.5-by-11-inch and 11-by-17-inch plain paper. Price: $2995 (1000); $2395 (1000 LE); $6995 (5000); $6295 (5000 LE). The products are shipping. XLI Corp. (Woburn, MA).

CIRCLE 170 ON INFORMATION CARD

Thermal Plotter

Ideal has released a direct-imaging, thermal-technology plotter. The Ideal/Contex FSP 4200 is specifically intended for high-speed raster image output. According to the company, an E-size image can be plotted in 90 seconds. Capabilities include selectable 400-by-200dpi or 200-by-200dpi resolution, a SCSI-2 interface, and platform independence. The transportable, 108-pound device can be used on either a desktop or optional floor stand. The plotter is supported by the company's CADimage software. Price: $10,900. Ideal Scanners & Systems (Rockville, MD).

CIRCLE 171 ON INFORMATION CARD

Pencil/Pen Plotters

Mutoh has announced three new models of its XP-500 pencil/pen plotters. The new devices are the XP-511 for A-D size, the XP-510 for A-E size, and the XP-510R for A-E size roll feed. Maximum plotting speed is 50 inches per second. Each plotter offers a high-capacity, automatic pencil lead feeder and a plotter carousel that holds up to eight drawing devices and is able to mix pen ink and pencil lead within the same drawing. Price: $4800 (D size); $6300 (E size), $7595 (roll feed). Mutoh America Inc. (Mt. Prospect, IL).

CIRCLE 172 ON INFORMATION CARD

Postscript Hardware RIP

Pacific Data Group has released a Postscript-compatible hardware RIP for Kodak XL dye-sublimation printers. The company says the FlexRIP uses an AMD 29000 RISC processor that cuts image-processing time on most Postscript files by 50 percent or more in comparison to software RIPs. The new RIP comes standard with 15M of DRAM, 35 Postscript-compatible typefaces, compatibility with Adobe Type 0, 1, and 3 fonts, and 24-bit color support. Price: $5995 (as part of a complete printing system); $7995 (stand-

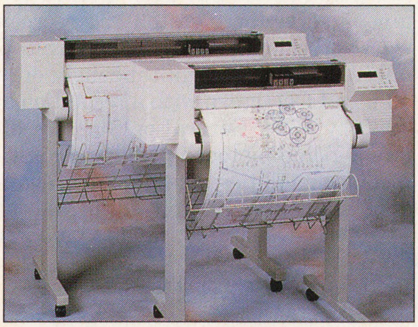
alone). The product is shipping. Pacific Data Group (Fremont, CA).
CIRCLE 173 ON INFORMATION CARD

Agfa Film Recorder

Agfa has announced Alto, a high-end digital film recorder that it says records 4000-line, 35mm slides in only 30 seconds. A sealed optical system prevents dust from entering the imaging area. The user can select 2K, 4K, or 8K addressability for any film format and up to 16K addressability for formats larger than 35mm. Also included are 36-bit color compensation for full saturation and smooth gradations, plus a downloadable firmware capability for easy upgradability. Price: $49,000. Agfa (Orangeburg, NY).
CIRCLE 174 ON INFORMATION CARD

Ink-Jet Plotter

Hewlett-Packard has announced an ink-jet plotter that it says provides higher performance than a pen plotter for an equivalent price. The new HP DesignJet 650C plotter operates in draft, final, and enhanced modes, outputting at up to 300dpi resolution in color and at an addressable 600dpi resolution in monochrome. D-size and E-size versions are offered. E-size plotting speeds range from less than five minutes to 18 minutes for color and from less than four minutes to 14 minutes for monochrome. Price: $8995 (E size); $7495 (D size). Shipment was scheduled for May. Hewlett-Packard Co. (Palo Alto, CA).
CIRCLE 175 ON INFORMATION CARD



Copier to Printer

ColorAge Inc. has introduced an interface kit for converting a Canon Color Laser Copier 300 or 500 into a continuous-tone printer. ColorQ Direct includes a ColorDirect interface board for connection to the copier, a five-meter cable, and Freedom of Press Pro, a Postscript language interpreter. Once installed in a '486 PC, the kit enables manual printing of Postscript files from any major platform, including PC, Mac, and Unix. Price: $9995 (32M version); $14,995 (64M version); $7500 (64M add-on memory board). ColorAge Inc. (Billerica, MA).
CIRCLE 176 ON INFORMATION CARD

Graphic Arts

Images and Poems

Iterated Systems has announced upgrades of Images Incorporated, its Windows desktop publishing software, and Poem ColorBox, a development kit for Windows imaging applications. Images Incorporated III adds support for new compression technologies, including FTT (Fractal Transform Template), which compresses groups of similar images. Poem ColorBox III includes an FTT editor, DLLs for compression, and runtime licenses. Price: $295 (Images Incorporated); $995 (Poem ColorBox). ColorBox III is shipping. Iterated Systems Inc. (Norcross, GA).
CIRCLE 177 ON INFORMATION CARD

Different Strokes

Claris Clear Choice has introduced two new packages for the Mac. BrushStrokes, a 32-bit paint and image-edit-

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ing program, includes such features as customizable brushes with special effects, tools for modifying image color and style, and color gradients and shading. RetrieveIt is a utility for finding files located on a Mac hard disk, floppy, CD-ROM, or file server. The software can search inside files or by file name for any specified text string. Price: $139 (BrushStrokes); $89 (RetrieveIt). Claris Corp. (Santa Clara, CA).

CIRCLE 178 ON INFORMATION CARD

Electronic Publishing

MultiMedia Imaging & Compression has introduced Windows-based electronic publishing software that features fractal image compression. Sho-Me lets the user publish an electronic book containing more than 100 photo-quality images, with descriptive text, on a single floppy diskette. Interactive command buttons are employed for structuring book format. The books produced are hardware-independent and viewable on any SVGA monitor. Price: $199. The product is available. Multimedia Imaging & Compression Services (Scarborough, Ontario, Canada).

CIRCLE 179 ON INFORMATION CARD

Systems

User-Configurable Notebooks

NEC has announced a series of '486-based notebook PCs that gives the user an extensive array of configuration options. The NEC Ultralite Versa Series offers a choice of a 20MHz, 25MHz, or 33MHz processor; an active-matrix TFT color or monochrome display; an 80M, 120M, 180M, or larger hard drive; and 4M of memory upgradable to 8M, 12M, or 20M. The user can also opt to remove the floppy drive and install a second battery instead, or to upgrade the system for pen input. Price: Starts at $2659. Shipment was scheduled for April. NEC Technologies Inc. (Boxborough, MA).

CIRCLE 180 ON INFORMATION CARD

Multimedia Workstations

Anigraphic has announced 17 workstations for multimedia, video, and digital imaging. The low-end model is the Matrix Gateway, a 33MHz, 68040-based computer that includes a 1Gbyte disk array, full-page 24-bit color display, Radius VideoVision, audio boards, speakers, a CD-ROM player, and software. The high-end Video Machine offers a 24-bit, 20-inch color display, A/B roll-editing control unit, digital effects unit, studio control box, four-channel stereo audio mixer, and more. Price: from $22,408 to $27,479. Anigraphic Productions Inc. (Silver Spring, MD).

CIRCLE 181 ON INFORMATION CARD

PRODUCTS

Design Engineering

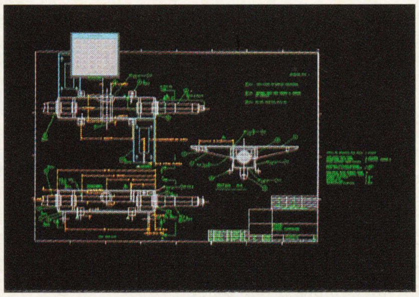
2D-to-3D Conversion

Artline Advanced Technology has announced a stand-alone "smart" tool that works with existing CAD software to create 3D models from 2D drawings. Called Link3D, the PC-based tool accepts 2D drawings in both DXF and HP-GL formats, so it's compatible with many CAD software packages. The designer can work in 2D space, 3D space, or both at the same time to better visualize the 3D model. Also, designers can extrude, revolve, and sweep 2D objects into 3D space. Artline Advanced Technology Inc. (Los Angeles).

CIRCLE 182 ON INFORMATION CARD

Cadam Emulation

Autodesk has announced Cadam emulation software for the desktop. The company says that the packages offer bi-directional compatibility with Cadam files. The programs are also compatible with Autocad Release 12. Aemulus, an ADS (Autocad Development System) with a Cadam-like graphics interface and command set, lets the user create and edit Cadam-compatible models. Aemulus_{mf} is a mainframe-resident program that enables the user to quickly convert Cadam 2D Interactive Drawing files to DXF or vice versa. Autodesk (Sausalito, CA).



CIRCLE 183 ON INFORMATION CARD

Mechanical Design

Parametric Technology has introduced two additions to its Unix-based Pro/Engineer mechanical design software. Pro/PDM, a package for managing large-scale parametric and associate design databases, provides customizable control over data access and security, release procedures, change propagation, project scheduling, and configuration management. Pro/DieFace is an advanced parametric tool for designing the die contact surfaces used in forming automotive body panels. Parametric Technology Corp. (Waltham, MA).

CIRCLE 184 ON INFORMATION CARD

Displays

Intelligent Display

Radius has introduced a 20-inch, Trinitron-based display system for high-end color applications. The IntelliColor Display/20 provides bidirectional communications between the microprocessor-controlled display and the computer, which allows for precise control of geometry, image size, centering, and color temperature. With the company's new IntelliColor software, which is included with the Display/20, the monitor is capable of refresh rates up to 160Hz and resolutions of up to 1600 by 1200. Price: $3199. The IntelliColor/20 began shipping in March. Radius Inc. (San Jose, CA).

CIRCLE 185 ON INFORMATION CARD

Flat-Panel X Terminal

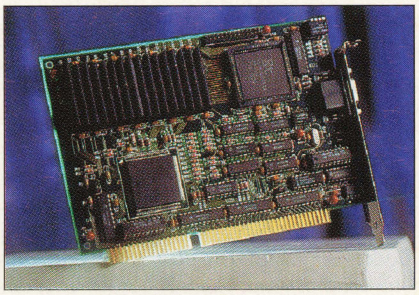
JCC has announced a new RISC-based, flat-panel, color X terminal. According to the company, the XfaceC incorporates all the features of JCC's monochromatic flat-panel series but adds a RISC engine, X server accelerator, large screen size, and color. At 25MHz, the XfaceC offers 256 colors simultaneously on a 13-inch LCD screen with a resolution of 1280 by 1024. Several options are offered, including touch panel and multimedia capabilities. The XfaceC is available immediately and is priced at $10,000 fully featured. Japan Computer Corp. (Fort Lee, NJ).

CIRCLE 186 ON INFORMATION CARD

Board Level

Fast Nth Board

Nth Graphics has announced a graphics board for ISA-bus PCs. Nth Edge 1280 supports a wide range of monitors with positive, negative, or composite sync. The board displays 16.7 million colors at 640-by-480 resolution, 256 colors at 1280-by-1024 resolution, or 32,000 colors at 1024-by-768 or 800-by-600 resolution. The three display modes are all noninterlaced, with either a 60Hz or 72Hz refresh rate. The board is bundled with Nth Drive display list software. A Micro Channel bus model is available. Price: $1195. Nth Graphics Inc. (Austin, TX).



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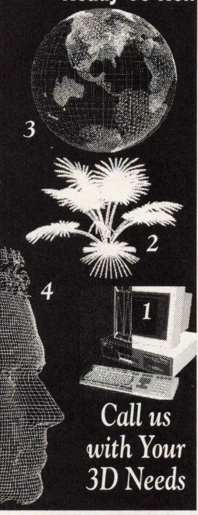

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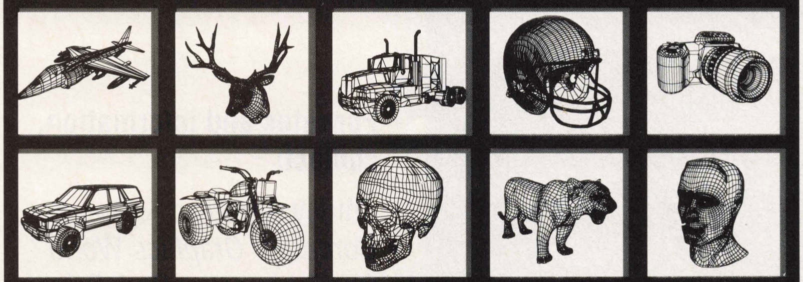

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Sales Offices

COMPUTER GRAPHICS WORLD

Paul McPherson
Group Sales & Marketing Manager
One Technology Park Drive
Westford, MA 01886
TEL:508-392-2172
FAX: 508-692-7806

NEW ENGLAND, EASTERN CANADA, UPSTATE NEW YORK
Alan Ventura, Regional Manager
One Technology Park Drive
Westford, MA 01886
TEL:508-392-2162
FAX: 508-692-7806

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SOUTH CENTRAL
Randy Jeter, Regional Manager
19627 Interstate 45 North, Suite 110
Spring, TX 77388
TEL:713-353-0309
FAX: 713-288-8350

LIST RENTAL
Deanna Rebro
PennWell Publishing Co., P.O. Box 1260
Tulsa, OK 74101
TEL:918-831-9551
FAX: 918-831-9497

SHOWCASE
Shirley Athorn
Direct Marketing Manager
One Technology Park Drive
P.O. Box 987
Westford, MA 01886
TEL:508-392-2183
FAX: 508-692-7831

LONDON
David T. Round
Westmead House
123 Westmead Road
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Surrey SM1 4JH, England
TEL:44-81-770-1100
FAX: 44-81-770-9779

PARIS
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MUNICH
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Mr. Mike Seah
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7500A Beach Road #06-322
The Plaza, Singapore 0719
TEL:65-299-0413
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HONG KONG
Mr. Tom Gorman
CCI Asia-Pacific Ltd.
Suite 905, Guardian House
32 Oi Kwan Road
Happy Valley, Hong Kong
TEL:852-833-2181
FAX: 852-834-5620

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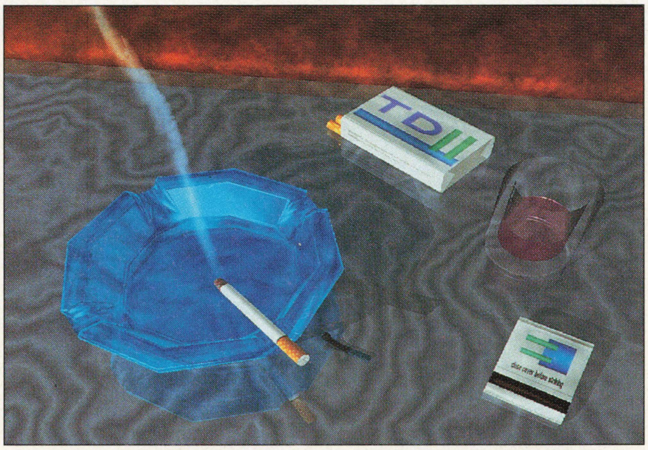
A Renaissance is Upon Us

The technology is in place for a profound renaissance in computer-generated art

By Thomas Dawson

The computer graphics industry is undergoing a fundamental change. In the past, when you wanted to assess a computer artist's skill, one of the first questions you would ask was the name of the platform he or she used. The idea was that if you knew the platform, you could make some assumptions about the quality of work the artist was capable of producing.



Can you guess which computer platform was used to create this image? Does it matter?

Today, that question has become virtually irrelevant. Now that all the popular platforms are capable of producing professional results, the need for artistic skill is rising while the importance of using a particular brand of equipment is diminishing.

Clients today are more concerned with *who* will be doing their computer graphics work and less concerned with the equipment choices of the artist. Just as a painting done by Picasso is appreciated for its style and not the brand of paint used to create it, so are the works of computer artists and animators beginning to be appreciated for the talent required to create them and not the equipment used to make them.

This rising importance of artistic talent in the field of computer graphics is especially interesting because of the parallels it shares with the developmental history of various other art forms, such as painting and photography.

The color purple, for example, is sometimes referred to as "the royal color" because, in the early days of painting, purple pigment was very difficult to make. This meant only the wealthy could afford it. Having the color purple in your painting came to be seen as a status symbol. In effect, the technical ability to create the paint was more important than the ability to paint the picture.

Eventually, the technical challenges involved were conquered, and the artist's skill became the most important factor in a work of art. Thus, painting evolved beyond its technical aspects to become a form of human expression.

A similar evolution also occurred in photography. The earliest photographers had to construct their own cameras. Being a photographer meant having the technical knowledge to build a camera and create and develop your own film. This began to change as cameras became available on the commercial market and camera films became standardized. But even at that point, the process used to manufacture cameras was so new that quality varied between the different brands. This, in turn, lead to assumptions about a photographer's ability based on the brand of camera used.

In time, competition between manufacturers had a leveling effect on camera quality. Today, anyone hiring a photographer probably doesn't think twice about the different brands of cameras. The only consideration is the skill of the photographer.

The fact that the computer graphics world has now reached its own level of technical maturity signals the dawning of a new age in computer graphics. In both painting and photography, the emerging dominance of artists over their tools led to a renaissance era. It was during these times that those who would be remembered in history as the grand masters of the art would flourish.

We are very close to a time when we can expect absolutely incredible things to happen in the computer

RENAISSANCE, *p.64*

Thomas Dawson is the chief animator at Animation Effects in Escondido, California.

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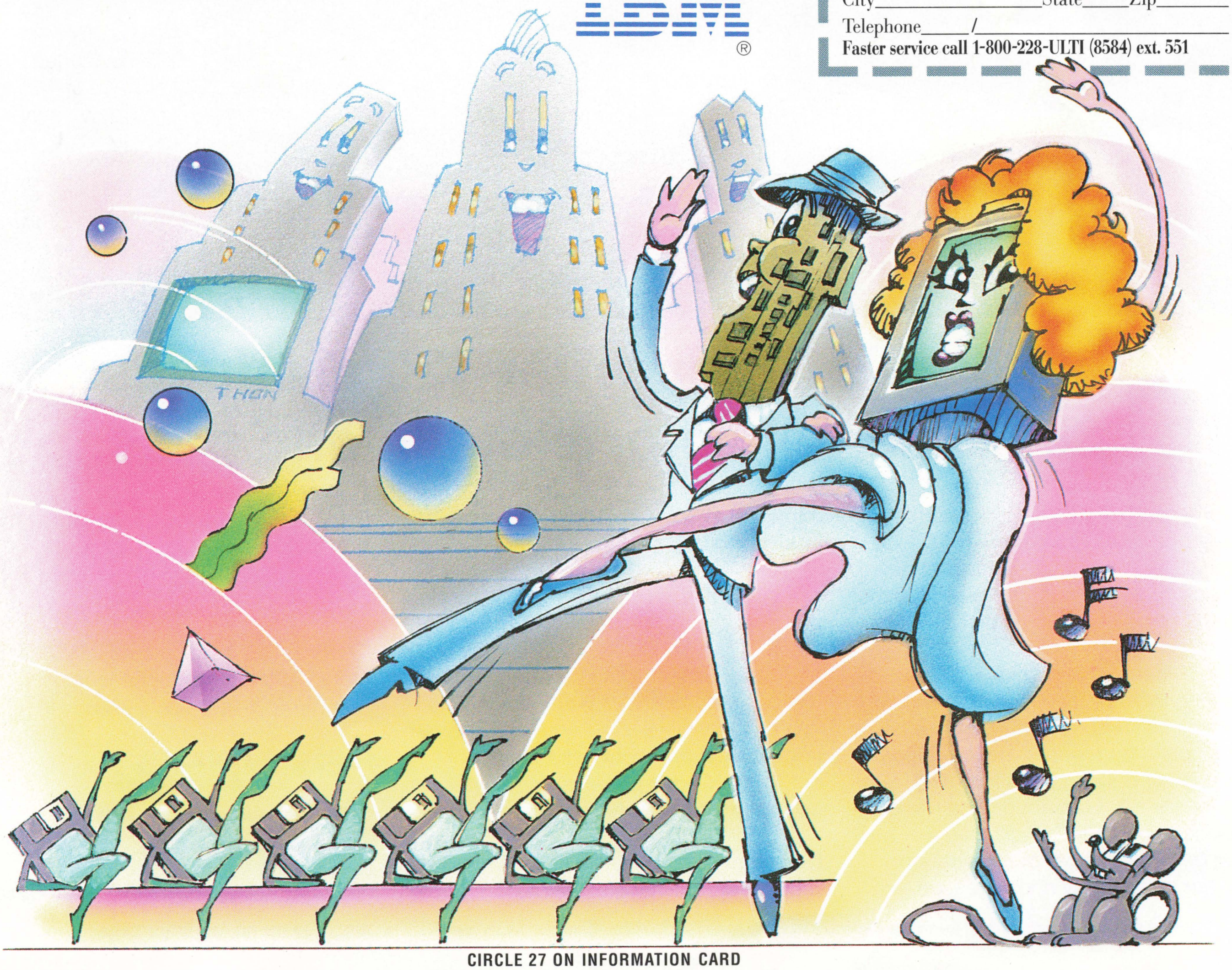

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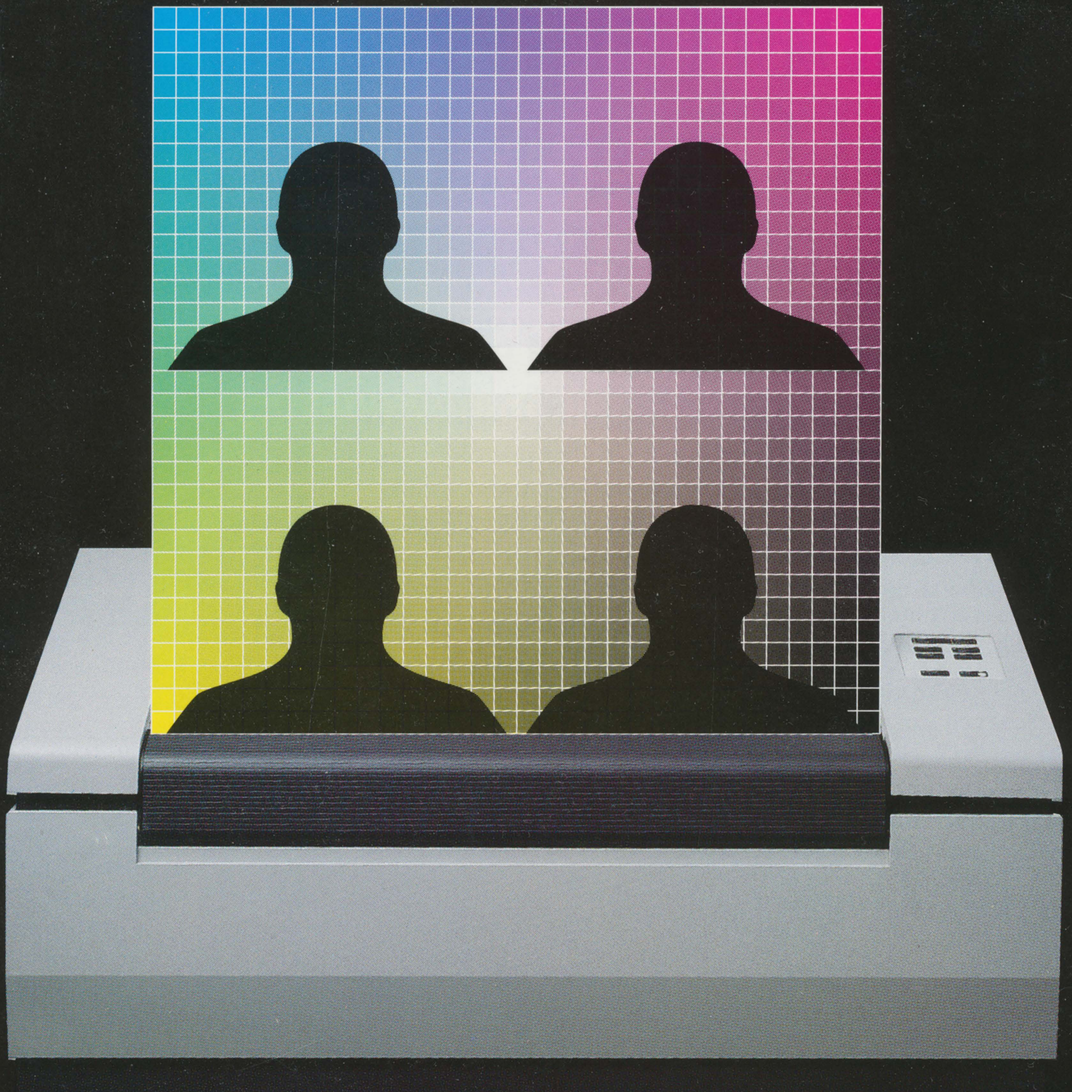

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